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Consulting Engineers and Scientists

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S.C. Dept. of Health & Environmental Control Bureau of Solid & Hazardous Waste Management

South Carolina Department of Health
and Environmental Control
2600 Bull Street
Columbia, S.C. 29201

Attention: Mr. John J. Schnabel, P.E.

RE: BARITE HILL MINE - INDUSTRIAL SOLID WASTE LANDFILL APPLICATION

Dear John,

At your request this letter is to confirm the transmittal of four copies of the report dealing with the proposed permitting of the heap leach facilities at the Barite Hill Mine as an industrial solid waste landfill. The original singed application is bound into one of the copies which also contains a duplicate in Appendix A thereof.

Also, as per request we will be forwarding four sets of the as-built drawings previously submitted to SCDHEC regarding the original construction of the heap.

We look forward to you or your departments assistance in this regard.

Yours Truly,

STEFFEN ROBERTSON AND KIRSTEN (U.S.), INC.

Rob Dorey, P.E.
Corporate Consultant

cc: Craig Kennedy, SCDHEC
Scott Wilkinson, Nevada Goldfields, Inc.

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SUPPORTING INFORMATION FOR APPLICATION FOR PERMIT TO CONSTRUCT A SOLID WASTE MANAGEMENT SYSTEM BARITE HILL PROJECT

Prepared for:
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April 25, 1995
SRK Project No. 14115

The document "Supporting Information for Application for Permit to Construct a Solid Waste Management System" dated April 25, 1995, has been prepared by Steffen Robertson and Kirsten (U.S.), Inc. under the direct supervision of Mr. Rob Dorey, Registered Professional Engineer in the State of South Carolina.

SOUTH CAROLINA
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No. 11355
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APPENDICES

1.0 INTRODUCTION

The Barite Hill Mine is a gold mining and processing operation located approximately three miles south of the town of McCormick in McCormick County, South Carolina (Figure 1). The mine is operated by Nevada Goldfields, Inc (NGI). Major project components associated with the mine include two open pit mines, waste rock disposal areas, a reusable heap leach pad, a permanent heap leach pad and an industrial solid waste landfill (Figure 2).

In 1992, Modification 92-1 of the State Land Resources Conservation Commission (SCLRCC) Mine Operating Permit (Mine Operating Permit No. 0852) was approved by the SCLRCC to construct a permanent heap leach pad in Waste Area C. The permanent heap leach facility was designed to contain approximately 1.4 million tons of oxide, sulfide and mixed ore.

The project Mining Permit included provisions for rinsing the spent ore heap to achieve the discharge limits set forth in the project National Pollutant Discharge Elimination System (NPDES) permit (Permit No. SC0043401). Rinsing of the heap at closure per permit requirements for cyanide detoxification purposes would result in a decrease in the pH level of the spent ore and an increase in the potential for acid rock drainage from the sulfide ore. Efforts to rinse the spent ore from the ruseable heap leach facility required an excessive length of time to meet regulatory criteria and an industrial waste landfill, Waste Area C Landfill, was permitted and constructed for disposal of a portion of the partially rinsed spent ore. Concerns for a similar lengthy rinsing schedule and the possible accumulation of a large inventory of solution in the process has prompted NGI to consider decommissioning and capping the permanent heap facility.

Therefore, NGI is proposing to close and reclaim the permanent heap leach facility as an industrial solid waste landfill. As the facility was constructed with a composite liner system to contain the ore and leach solutions, and is equipped with a drainage pipe network to minimize solution head on the liner system, it has in essence been constructed as an industrial solid waste landfill.

Industrial solid waste landfill (ISWLF) units in South Carolina are permitted under the State's Solid Waste Management Act (South Carolina Code of Laws, Title 44, Chapter 96 - Solid Waste; Enacted by South Carolina Acts of 1991, No. 63) under the jurisdiction of South Carolina Department of Health and Environmental Control (DHEC), Office of Environmental Quality Control, Bureau of Solid and Hazardous Waste Management.

Industrial solid waste landfills are regulated under Regulation 61-66 (South Carolina Code of Regulations, Chapter 61 - Department of Health and Environmental Control, Regulation 66 -

Industrial Waste Disposal Sites and Facilities; Adopted March 8, 1972; Effective March 16, 1972). The Solid Waste Policy and Management Act of 1991 requires DHEC to promulgate new regulations for all aspects of solid waste management included ISWLFs. The new regulations are being drafted but will not become effective until two years after publication in the State Register. Therefore, the new regulations do not apply to the Barite Hill project.

This report provides supporting information for the Application for a Permit to Construct a Solid Waste Management System (Appendix A), and contains a description of the reports, studies and permits that apply to the design and operation of the permanent heap. This information is contained in the following subsections. A summary of the site analysis for the heap leach facility is in Section 2.0. Section 3.0 describes the engineering design of the heap leach facility and the waste characteristics of the ore. Closure of the heap leach facility/landfill, including a description of the final cover, surface water management and stability of the final configuration is discussed in Section 4.0.

A summary of practices to be used during reclamation of the facility is included as Section 5.0. Section 6.0 describes the post-closure care and maintenance of the heap leach facility/landfill including monitoring and maintenance of the final cover, leachate management and groundwater monitoring. Section 7.0 is a summary of the existing financial assurance for the mining project.

1.1 Existing Facilities

The general facilities arrangement of the Barite Hill Mine is shown on Figure 2. Major components associated with the Barite Hill Mine include a reusable heap leach pad and pond facilities, a solid waste disposal landfill and collection pond facilities (Waste Area C Landfill), and the permanent heap leach pad and pond system. The permanent leach pad is located adjacent to the solid waste landfill and is included in the area originally designated as Waste Area C (Figure 2).

The reusable pad and pond facilities include an asphalt-lined pad and double synthetically lined pregnant, barren and rinse ponds. Waste Area C Landfill was permitted as an industrial solid waste landfill to store partially rinsed spent ore from the reusable pad that could not meet the stipulated leachate water quality standards. The landfill facilities include a synthetically lined fill area, collection ditch and synthetically lined collection pond. These facilities were permitted and operated by Gwalia (USA), Ltd, a subsidiary of NGI.

The reusable leach pad and solid waste landfill were decommissioned at the start of the permanent pad Phase I operations. The landfill collection pond continues to collect leachate from the landfill.

Use of this pond is also made in storing solutions associated with the permanent pad heap leach operations.

1.2 Existing Information

The permanent heap leach facility has been designed, permitted, constructed and operated in compliance with SCDHEC approved reports and applications. As such numerous reports, studies and permits exist pertaining to this facility.

1.2.1 Previous Studies

The permanent heap leach facility is located in Waste Area C adjacent to the Waste Area C Landfill. A siting investigation of Waste Area C was completed for design and permitting of the landfill. Studies conducted for the siting investigation also apply to the heap leach facility. The studies are contained in the following report:

- DP Engineering, Inc with Environmental Technology Engineering, Inc, and Water, Waste & Land, Inc (1990) "Rinsed Agglomerate Disposal Facility, Final Design Report", March (DP Engineering et al. 1990).

The permanent heap leach design and construction details are included in the following reports:

- WESTEC (1992a) "Final Design Report for the Permanent Heap Leach Facilities", January. (WESTEC 1992a).

- WESTEC (1992b) "As-Built Report for the Barite Hill Gold Project Permanent Heap Leach Pad and Ponds", October (WESTEC 1992a).

Throughout the phased construction of the heap area quality assurance and control (QA/QC) was provided for the work under the approved specifications and construction permit. These various reports have been submitted to SCDHEC and are listed below:

- Steffen Robertson and Kirsten (U.S.), Inc. (1993) "Report of Quality Assurance/Quality Control Testing of Earthwork Construction and Liner Installation, Barite Hill Project", February (SRK 1993a).

- Steffen Robertson and Kirsten (U.S.), Inc. (1993) "Quality Assurance/Quality Control Testing and Inspection of the Earthwork and Geosynthetic Installation for the Nevada Goldfield Project", December (SRK 1993b).

- Steffen Robertson and Kirsten (U.S.), Inc. (1994) "Quality Assurance/Quality Control Testing and Inspection of the Earthwork and Geosynthetic Installation for the Nevada Goldfield Project Heap Leach Pad Phase II, Stage II", May (SRK 1994).

Other reports pertaining to the heap are listed below:

- Nevada Goldfields, Inc. (1992) "Barite Hill Project, Reclamation Plan Update, Mining Permit No. 0852, Construction Permit No. 16,225", January 1992 (Nevada Goldfields 1992).

1.2.2 Permits

Permits that have been obtained for the permanent heap leach facility are listed below:

- Permit to Construct (No. 17,334-IW) from DHEC for construction of a permanent heap leach pad and pond system. Issued July 24, 1992; expired July 24, 1994.

- Permit to Operate from DHEC to operate a permanent heap leach pad and pond system. Issued September 28, 1992.

- Permit to Operate from DHEC to operate a permanent heap leach pad and pond system. Issued March 1, 1993.

- Permit to Construct (No. 17,334-IW) from DHEC to construct a contingency pond for emergency overflow.

- Permit to Operate from DHEC to operate a contingency pond for emergency overflow. Issued March 1, 1993.

Other permits acquired for the Barite Hill Project are listed below:

- Permit for Mining Operation No. 0852 from SCLRCC for the Barite Hill Mine. Issued August 14, 1990; expires August 14, 1995. Approval to change Waste Area C to a permanent leach pad facility granted July 27, 1992 (Modification 92-1).

- NPDES Permit No. SC0043401 (Water Pollution Control Permit) from DHEC for the Barite Hill Mine. Issued October 12, 1989; expired October 31, 1994.

- State Air Quality Permits to Construct No. 1600-0006-CA, CB, CC, CD and CE from DHEC for construction of ore crushing and processing facilities. Issued June 12, 1990.

- State Air Quality Permit to Operate No. 1600-0006 from DHEC for operation of ore crushing and processing facilities. Issued February 19, 1993; Expires February 28, 1998.

2.0 SITE DESCRIPTION

2.1 Location

The mine site is located approximately three miles south of McCormick, South Carolina as shown on Figure 1. Clark Hill Reservoir (a.k.a. Sloan Lake) on the Savannah River is approximately 3 miles west of the project site. The mine site is relatively remote; there are no buildings, homes or commercial buildings within .50 miles of the boundary. Thick woodlands surround the mine site with a gate across the only access road.

The site is located along a topographic high ridge area forming the head waters of an unnamed tributary to Hawe Creek. The topography of the area consists of rolling hills with ridgelines at an elevation of approximately 500 ft. Within the site, the ridgeline comprising the site has a high point at about 510 ft and an average elevation of approximately 480 ft. Waste Area C, which includes the permanent heap leach facility and Waste Area C Landfill, has an elevation of approximately 450 to 480 ft.

The permitted mine site totals 795.2 acres. Of this total, 659.7 acres are designated as buffer area (areas not disturbed beyond the pre-mine natural state); therefore the maximum disturbance area is 135.5 acres. The permanent heap leach facility occupies approximately 16.3 acres of the maximum disturbance area.

2.2 Vegetation and Wildlife

The following is summarized from the U.S. Army Corps of Engineers Nationwide Permit No. 26 Notification Form and Supporting Documentation which includes The Vegetation, Wildlife and Threatened and Endangered Species Study and the Wetlands Evaluation and Restoration (Environmental Technology Engineering 1989).

The area was originally timbered with a mixture of second growth pines and hardwoods and much of the property has since been disturbed by mining activities. The mine site is not within the boundaries of any areas designated as "Wildlife Management Areas" by the State Wildlife and Marine Resource Agency. The current permanent heap leach facility is void of vegetation and wildlife.

An environmental survey, conducted on March 10, 1989, indicated that no protected species of plants or animals were found on the mine site. A U.S. Army Corps of Engineer 404 permit was obtained as a result of the potential occurrence of protected plant species common to wetlands.

2.3 Climate

The mine site is located in an area of moderately high precipitation with an average annual precipitation of approximately 47 inches and average annual lake evaporation of 46 inches. The permanent heap leach facility designs have been based on the precipitation and evaporation obtained from the weather station at Clark Hill Dam after D.P. Engineering, Inc. et al. (March 1990). This data is presented in Table 1.

The 100-yr, 24-hr storm event has been estimated at 8 inches while the 10-yr, 24-hr storm event is 5.5 inches.

TABLE 1
CLIMATE DATA
CLARK HILL DAM WEATHER STATION

Month	Avg. Precip. (inches)	Avg. Evap. (inches)
JAN	4.88	0.00
FEB	4.21	2.11
MAR	5.07	3.76
APR	4.11	5.22
MAY	3.99	5.94
JUN	4.00	7.30
JUL	4.73	6.90
AUG	3.93	5.79
SEP	3.80	4.16
OCT	2.60	3.42
NOV	2.54	1.92
DEC	3.64	0.00
Annual Total	47.50	46.52

2.4 Land Status

The mine site consists of 203.7 acres owned by NGI and 591.5 acres of leased land for a total of 795.2 acres. No federal lands were impacted by the mining project. Under the Mining Permit (No. 0852), NGI is permitted for a total disturbance area of 135.5 acres.

2.5 Geology

2.5.1 Regional

Barite Hill is located in a division of the Piedmont Physiographic Province referred to as the Carolina Slate Belt that extends from near McCormick southwest into Georgia. This is a belt of medium grade metamorphic rock and early to middle Cambrian volcanic, volcanoclastic, and epiclastic sedimentary rocks. It is bounded on the west by higher grade metamorphic rocks, (late Precambrian volcanic) and epiclastic sedimentary rocks of the Charlotte Belt and on the east by the Modac Fault, a zone of extensive ductile shearing and mylonitization (fine-grained laminated rocks formed during movement on fault surfaces).

The mine site lies within a stratigraphic assemblage of the Persimmon Fork Formation as shown on Figure 3. This assemblage consists of basal Lincolnton Metadacite, which is conformably overlain by a northeast-trending sequence of metamorphosed felsic volcanics, intermediate volcanics, felsic volcanoclastics, and clastic sediments. Typical Lincolnton Metadacite is a blue quartz crystal porphyry with quartz-feldspar matrix.

The felsic volcanics are dominantly composed of quartz and feldspar crystal tuffs with a quartz-sericite matrix. Vitric and lapilli tuffs are a minor component. Intermediate volcanics are feldspar crystal tuffs with a chlorite-rich matrix. These interfinger with felsic volcanoclastics that are composed of interstratified felsic volcanics and clastic sediments. The clastics mostly are medium to coarse-grained argillaceous sandstones, although fine-grained, laminated to thinly bedded lithologies are present locally.

The felsic and intermediate volcanics and felsic volcanoclastics display a well-developed foliation that generally strikes on a bearing of 55 degrees and dips 80 degrees northwest. Locally preserved bedding planes strike on a bearing of about 45 degrees and commonly are subvertical to steeply northwest dipping. Stratigraphic facings, as revealed by grading and turbiditic couplets, are oriented southeast.

2.5.2 Site Geology

The mine site is underlain by a northeast-trending sequence of greenschist facies, felsic volcanoclastics, intermediate volcanics, felsic volcanics and clastic sediments as shown on Figure 3. This area is located within a stratigraphic assemblage consisting of basal Lincolnton Metadacite.

An investigation consisting of a series of boreholes, test pits and trenches was conducted in the permanent leach pad area. WESTEC Drawing No. 03110-03 (WESTEC 1992a) shows the trench, test pit and borehole locations. The four surface exploration trenches excavated in the northwest area of the permanent pad site indicate the primary bedrock beneath the site is the metasediments with inclusion of the northeast-trending sequences as described. The trenches were excavated in a northwest strike and down to refusal or the limits of the backhoe (DP Engineering et al. 1990).

Saprolite formations were encountered near the ground surface and consist of very weathered rock that has been broken down to clayey soil often retaining structures of the original rock. This saprolite material was encountered to depths of 3 to 25 ft in the proposed landfill area. Exposed in the trenches were felsic crystalline tuff and quartz-feldspar porphyry dikes or sills. The metasediments separated the two units. The occurrence of the dikes or sills was not logged in the two eastern trenches (T3 and T4). Trench geologic summary logs provided by NGI are presented on Figure A-5 in Appendix A of the WESTEC (1992a) report with detailed geotechnical logs by SRK presented in Appendix B to WESTEC (1992a).

A more detailed description of the Waste Area C geology is presented in "Rinsed Agglomerate Disposal Facility, Final Design Report" (DP Engineering et al. 1990).

2.6 Seismicity

A brief assessment of the mine site seismicity was made from published data. From charts in U.S. Army Corps of Engineers (1983), the site is in a Zone 2 area, corresponding to a seismic coefficient of 0.10 g, where g is gravitational acceleration. The maximum horizontal rock acceleration at the site would be approximately 0.10 g, from maps published by Algermissen et al. (1982 and 1990), for a 90 percent probability of not being exceeded in 50 years, and 0.20 g for a 90 percent probability of non-exceedance in 250 years. These probabilities correspond to recurrence intervals of 475 and 2373 years, respectively.

There are no known active faults at or in close proximity to the site nor is there any known occurrence of measurable surface fault rupture from any historic earthquakes in the Coastal Plain of the southeastern U.S.

Performance of the permanent heap leach facilities under earthquake loading conditions has been conducted using the seismic coefficient or pseudostatic method. As the facility will be neither highly sensitive to minor earthquake induced deformations or subject to drastic strength reductions under earthquake loading, (i.e. liquefaction), a pseudostatic type of analysis was deemed appropriate (Hynes-Griffen and Franklin 1984; Seed 1979). For a pseudostatic stability analysis, the effects of an earthquake on a potential slide mass are represented by an equivalent horizontal force which is the product of the weight of the potential slide mass times a seismic coefficient, (which is some percentage of gravitational acceleration). The seismic coefficient is selected to represent the average or sustained earthquake loading which is conservatively assumed to act at right angles to and out of the embankment face. This seismic coefficient is generally taken to be in the range of 40 to 70 percent of the peak ground acceleration (PGA) (Jansen, 1985). The Corps of Engineers (Hynes-Griffen and Franklin, 1984) recommends a seismic coefficient of 50 percent of the PGA.

A seismic coefficient of 0.05 g was selected for the original heap leach design purposes and a coefficient of 0.10 g has been selected for evaluation of the long term stability of the landfill. The coefficients were selected based on the estimates of a PGA for various exposure periods from Algermissen, et al. (1982 and 1990).

2.7 Hydrology

2.7.1 Surface Water

The Clark Hill Reservoir on the Savannah River is approximately 3 miles west of the project site. The most significant surface drainages at the mine site are two tributaries to Hawe Creek. One perennial tributary runs along the north side of the mine site. The second tributary, which appears to be ephemeral, starts on the south side of the site and then drains northward along the west side of the mine site. The confluence of the two tributaries is about 200 ft northwest of the overall property boundaries. An intermittent creek is on the east side of the mine site (Environmental Technology Engineering 1989).

An environmental survey was conducted on March 10, 1989, which included wetlands locations (Environmental Technology Engineering 1989). A U.S. Army Corp of Engineers 404 permit was obtained for the mine site as a result of the wetlands identification (Permit for Mining Operation No. 0852).

There are no creeks or streams running through the proposed mine site. Therefore, surface water at the mine site is limited to surface runoff, during and shortly following precipitation events. The runoff is directed down the slopes and out of the drainage area through defined drainage courses in the topography (see Drawing 03110-03 from WESTEC, 1992a). NPDES Permit No. SC0043401 allowed for the discharge of stormwater runoff to Hawe Creek, (designated as "Class B" in accordance with Water Classifications and Standards, Reg 61-69). The 7Q10 (minimum seven-day average flow that occurs with an average frequency of once in ten years) for the drainage area is zero.

Waste Area C is located at the top of the catchment drainage area so that minimal diversion ditches were required for the permanent heap leach pad facility. The existing haul road bordering the northwest side of the pad marks the ridge drainage boundary. The haul road surface was graded to drain to the northwest away from the pad site drainage.

For closure of the existing permanent leach pad facility as an industrial waste landfill, the existing diversion ditches will be upgraded and supplemented with additional diversion ditches to control runon and runoff from the landfill area. Further description of surface water management for the landfill facilities is presented in Section 4.4.

2.7.2 Groundwater

A hydrogeologic study of Waste Area C was conducted for the design of the Waste Area C Landfill (DP Engineering et al. 1990). This section summarizes pertinent groundwater conditions presented in the 1990 report.

Three zones of groundwater have been identified underlying the site. The zones are hydraulically connected; therefore, no isolated or perched water table conditions are expected to exist below the site. The first and upper zone exists within the saprolitic materials (extremely degraded and weathered bedrock and colluvial soils with bedrock-like structures and fractures). The second zone is within the fracture system of the underlying weathered bedrock. The third zone is within the competent bedrock designated as the Igneous and Metamorphic Bedrock Aquifer System.

All three zones exhibit similar horizontal gradients in a southerly direction consistent with the relief of the topographic expression. The hydraulic conductivity from one zone to the next is relatively different and is a function of the material. The average hydraulic conductivity as measured in the field within the saprolitic material is about 0.05 ft/day.

Based on field observations (DP Engineering et al. 1990), the hydraulic conductivity of the upper portion of the saprolitic material and colluvial clay soil covering the site may be as much as one or two orders of magnitude lower. This is because the secondary features of the lower saprolitic material (i.e., fractures, joints and bedding planes), which control the hydraulic conductivity, are less prominent or nonexistent in the near-surface materials. Therefore, hydraulic conductivity is controlled by primary flow patterns (i.e., through the pore structures of the material) rather than the "open" secondary structures. Due to the fine-grained particle size and clayey consistency of the surface materials, the hydraulic conductivity would be lower. Laboratory tests show that this material can be compacted to a density at which the hydraulic conductivity test value is on the order of 0.003 to 0.0003 ft/day.

The middle zone (weathered bedrock) has an average hydraulic conductivity of 0.18 ft/day. This increased value is probably a result of more open fracture and joint patterns in the bedrock. The more "open" secondary fractures are likely a result of oxidation and leaching out of the joint and fracture fillers and relief of confining pressures in the near-surface bedrock.

The lower zone of competent bedrock exhibited a hydraulic conductivity of 0.019 ft/day and 0.09 ft/day in the two boreholes used in the field tests.

The vertical gradient in the lower groundwater zone is upward to the intermediate zone. The upper bedrock zone or intermediate groundwater zone exhibits a higher hydraulic conductivity than the saprolitic material, thus acting as a receptor and interrupting the upward gradient to the surface. In turn, the gradient from the saprolitic material to the upper bedrock is downward.

A series of 25 monitor wells have been installed in and around the existing leach pad site as shown on WESTEC Drawing 03110-03 (WESTEC 1992a). Figure 4 presents a generalized potentiometric contour map of the existing heap leach/proposed landfill site. As shown on this figure, groundwater flow is generally towards the south and mirrors surface topography. The groundwater table is on the order of 50 ft below ground surface towards the northern edge of the facility and 15 ft along the southern edge.

The upward gradient, the clayey saprolitic soils (3 to 25 ft) and the depth to the water indicate that the site is suitable for the waste disposal facility. The natural geologic system present was augmented by 1 foot of clay liner compacted to achieve a hydraulic conductivity of 10^{-6} cm/sec. The site is therefore considered to offer adequate protection to the groundwater (DP Engineering et al. 1990). More detail on aquifer testing and characteristics is presented in the DP Engineering et al. (1990) report.

2.7.3 Private Well Survey

In conjunction with the hydrogeologic studies of Waste Area C, a private well survey was conducted on January 8, 1990, within a one mile radius of the site. Twelve homes with private wells were identified, located south and southeast of the site. A map of all twelve homes is given in Figure 5. Table 2 presents the individual well information available from each resident. Ten of these homes, according to available information, are connected to county water lines for domestic water consumption. Well water is used for gardening at these homes. The two residents who are not served by county water, Mr. Wall and Mr. Parker, are distinguished separately on the map (Figure 5). These two residents use well water for gardening and domestic consumption. The wells utilized for domestic consumption are located more than 750 ft hydraulically downgradient of the site.

TABLE 2
WATER WELL SURVEY

Figure I.D. No.	Name	Use	Depth	Date Installed	Drilling Method
1.	Mr. Lewis	Garden	80 ft	Unknown	Unknown
2.	Bob Wall	Domestic	190 ft	1950	Cable tool
3.	Ray Wall	Garden	60 ft	Unknown	Unknown
4.	Mr. McKee	Garden	44 ft	1972	Unknown
5.	Unknown	Unknown	338 ft	1980	Cable tool
6.	Unknown	Unknown	Unknown	Unknown	Unknown
7.	Mr. Edmunds	Unusable	100 ft	1970	Unknown
8.	Hazel Freeland	Garden	Unknown	1967	Unknown
9.	Allen Jennings	Unknown	Unknown	Unknown	Unknown
10.	Allen Freeland	Unknown	Unknown	Unknown	Unknown
11.	Mr. Brenner	Unknown	Unknown	Unknown	Unknown
12.	Mr. Parker	Domestic	100 ft	1975	Unknown

3.0 EXISTING PERMANENT HEAP LEACH FACILITY

3.1 General

The proposed landfill facility was initially constructed as a permanent heap leach pad in the summer and fall of 1992 in conjunction with mining activities at the site. A total of approximately 16.3 acres of leach pad and associated solution ponds were constructed in several phases. A detailed description of the leach pad facility design is contained in the report prepared by WESTEC dated January, 1992 (WESTEC 1992a). A series of drawings numbered 03110-01 through 03110-08, prepared in conjunction with that report, depict the details of the facility. Figure 2 and WESTEC Drawing No. 03110-02 (WESTEC 1992a) shows the general layout of the mine facilities while WESTEC Drawing No. 03110-03 depicts the heap leach facility layout.

These facilities were incorporated into the mine operating permit (No. 0852) as Modification 92-1 which was approved by the SCLRCC on July 27, 1992.

This section of the report summarizes the pertinent design and construction details of the heap leach facilities as they apply to closure of the facility as an industrial waste landfill.

3.2 Leach Pad Liner

The permanent leach pad was constructed with a composite liner system. The area was stripped of topsoil and organic debris prior to site grading. These materials were stockpiled for future reclamation. Following minor grading, the subgrade was proofrolled and the silty and clayey saprolite material within the limits of the leach pad was spread and compacted to create a minimum 1 ft thick soil liner. Permeability testing of this material when compacted to the minimum density specified ranged from 4.9×10^{-7} cm/sec to 1.2×10^{-6} cm/sec and averaged 7.9×10^{-7} cm/sec (4 tests).

Construction records (WESTEC 1992b; SRK 1993a, 1993b, 1994) indicate that compaction of the soil liner material typically exceeded the minimum density specified, frequently to a considerable extent, and thus the actual soil liner should exhibit lower permeabilities.

The soil liner component is overlain by a polyvinyl chloride (PVC) geomembrane liner. This type of geomembrane was selected for the facilities due to its flexibility, adaptability to foundation settlements, higher interface friction properties for stable heap slopes, and superior puncture resistance to static and dynamic construction loads.

Phase I of the leach pad construction, which amounted to approximately 6.3 acres, incorporated a 40 mil PVC liner and included the placement of ultra-violet resistant PVC (UV-PVC) liner in areas exposed to more than 6 months of sunlight, such as the perimeter of the pad. Phase I construction and liner installation details are presented in the report prepared by WESTEC (1992b).

Phase II of the leach pad construction, which amounted to approximately 3.1 acres, incorporated 50-mil PVC liner and included UV-PVC in areas to remain exposed. Phase II construction and liner installation details are presented in "Report of QA/QC Testing and Inspection of Earthwork Construction and Liner Installation, Barite Hill Project" (SRK 1993a).

Stage I of the Phase III leach pad construction, which amounted to approximately 3.1 acres, also incorporated 50-mil PVC and UV-PVC liner. Phase III, Stage I construction and liner installation details are presented in "QA/QC Testing and Inspection of the Earthwork and Geosynthetic Installation for the Nevada Goldfield Project" (SRK 1993b).

Phase III, Stage II of the leach pad construction, the final phase of pad construction, also incorporated 50-mil PVC and UV-PVC liner over an additional 3.7 acres of pad area. Phase III, Stage II construction and liner installation details are presented in "QA/QC Testing and Inspection of the Earthwork and Geosynthetic Installation for the Nevada Goldfield Project, Heap Leach Pad Phase III, Stage II" (SRK 1994).

The equivalent permeabilities of the PVC and UV-PVC liners is estimated to be on the order of 1×10^{-11} cm/sec (Giroud and Bonaparte, 1989).

The above-referenced QA/QC reports summarize the testing and inspection of earthwork construction and geosynthetic liner installation procedures for the leach pad. These reports document that materials placed, and workmanship during the construction of the leach pad facility complied with the technical specifications.

3.3 Drainage System

A system of perforated polyethylene drain pipes was placed directly on the pad liner to provide drainage at the base of the ore. These pipes were placed at grades varying from roughly 5 to 1 percent to provide gravity drainage. The drainage pipes daylight at the toe of the heap to discharge to the perimeter collection ditch.

The drain pipe system includes 3-inch diameter lateral drain pipes on 50-ft centers which are connected to 6-inch diameter primary or main drain pipes. Drain pipe spacing was designed to maintain hydraulic heads on the liner of less than 2 ft during active leach solution application to the heap at the rate of 0.005 gpm/ft^2.

3.4 Solution Ponds

A series of 3 solution collection ponds were constructed adjacent to the leach pad facilities for containment of the leach process solutions and storm run-off from the heap leach pads. The leach pad and ponds are shown on WESTEC Drawing 03110-03 (WESTEC 1992a) . Drawing 14115-001 depicts the current as-built configuration of the heap leach facilities. Table 3 gives the capacity of each of the solution ponds.

TABLE 3
SOLUTION POND CAPACITIES

Pond	Capacity w/2 ft freeboard (gallons)	Ultimate (gallons)
Barren	6.864×10^6	8.25×10^6
Pregnant	1.58×10^6	2.06×10^6
Rinse	1.08×10^6	1.43×10^6

The barren pond is lined with a double liner and leak detection system. This liner system consists of a minimum 1 ft thick soil liner with a maximum permeability of 5×10^{-6} cm/sec which is overlain by a 40-mil high density polyethylene (HDPE) liner followed by a HDPE geonet on the pond base and filter fabric on the side slopes and finally a 60-mil HDPE primary liner. The geonet between the two HDPE liners is connected to a sump filled with pea gravel at the lowest point in the base of the pond. This sump is monitored for leakage through the upper liner via an observation well installed in the sump. Leachate collected from the existing landfill is routed via a ditch to this pond.

The pregnant and rinse solution ponds were also constructed with a double liner and leak detection system. The liner systems for these ponds consists of a minimum 1 ft thick sandy clay soil liner with a minimum of 55 percent by weight finer than a No. 200 sieve size (.074 mm) which is overlain by a 30-mil PVC liner followed by a geonet and filter fabric leak detection layer and finally a 40-mil UV-PVC primary liner.

The geonet layer on the base of the pond is connected to a gravel filled sump at the pond low point. The sumps are monitored for leakage via an observation well installed in the sumps.

Pond construction details are documented in the SRK (1992) and WESTEC (1992b) reports.

3.5 Diversion System

An open ditch diversion system and berms were incorporated into the facility design to divert natural runoff around the leach pad and solution ponds. The ditch alignments are depicted on WESTEC Drawing 03110-03 (WESTEC 1992a). Haul roads adjacent to the leach pad and ponds were graded to drain away from these facilities. All diversions were designed to meet the requirements of the 100-yr, 24-hour design storm event.

3.6 Ore Heap

The heap pad was designed to accommodate 1.4 million metric tons of ore with a heap height of 70 ft. The ore was placed on the heap in 35 ft lifts with 2H:1V overall side slopes. Drawing 14115-001 depicts the current heap configuration and shows that the final 35 ft lift was not placed on approximately half of the pad area.

Ore placed on the leach pad was prepared by crushing to a minus 0.5 inch size and agglomerated with a cement additive to a typical maximum size of 1 inch. Cement was typically added as a rate of 10 pounds (lbs) per ton of ore. The ore was placed on the leach pad by a radial stacker conveyor with each lift construction at the ore's angle of repose.

3.7 Waste Characteristics

3.7.1 Physical

The ore was placed on the heap at a density of approximately 100 lbs/ft^3 (pcf). Degradation of the agglomerated ore through the leaching process has resulted in a material which can be characterized as a gravely silty sand. Figure 6 shows the results of a grain size analysis of a typical sample of spent ore. The permeability of the spent ore is estimated to be on the order of 1 x 10^{-4} cm/sec. When compacted to 90 percent of the maximum dry density as determined by ASTM D-1557 the spent ore exhibited a permeability of 1.2 x 10^{-6} cm/sec.

The surface of the heap has been subject to extensive irrigation during the leaching process and the fine ore particles have been washed into the underlying void spaces; therefore, the heap does not present dusting problems. The materials do not exhibit disease vector, fire, odor, scavenging or litter concerns.

3.7.2 Geochemical

Ore sample composites were tested for environmental-related parameters by McClelland Laboratories in 1988. This information is presented in Appendix L of Waste Area C Landfill Design Report (DP Engineering et al. 1990). The testing included mercury analyses on head ores (11 composites); heavy metal analyses of pregnant solutions from the first 10 days of column leaching (7 composites); analyses of column leach residues which were washed with water for 10 days after leaching; and EP Toxicity and modified EP Toxicity tests of washed leached residues to determine heavy metal attenuation and soluble threshold limit concentrations (STLC) of various metals.

Mercury levels in the head ores were low and ranged from 0.105 to .980 ppm. Copper and selenium were detected in the pregnant solutions; however, copper was the only metal detected in any significant quantity (0.9 to 313.0 ppm).

Wash solutions were analyzed every other day for copper, lead, mercury, selenium and cyanide. Lead and mercury were not detected in the wash solutions. Copper and selenium were detected at only low levels in the wash solutions. Cyanide concentrations decreased indicating that water washing was effective in detoxifying the leached ore.

EP Toxicity and Modified EP Toxicity Methods (California [CAM-WET] and deionized water) were used to determine STLC values of heavy metals in the washed leached residues. Concentrations of barium, chromium, arsenic, cadmium, lead, mercury, selenium and silver were either not detected or were very low and below EPA threshold levels.

Based on the above test results, the spent ore would not be characterized as hazardous under 40 CFR 261. However, rinsate water chemistry and leachate analyses did not meet the permit levels for off-loading from the pad and required the permitting and construction of a landfill for disposal of the spent ore materials.

The ore contained in the permanent heap is oxide ore, mixed ore and sulfide ore of similar characteristics to that previously tested. Phase 1, 2 and parts of the Phase 3 pads contain primarily oxide ore. Acid-base accounting test results of the sulfide ore indicate that the bulk of the material has a potential to be acid generating (Knight Piésold 1993).

3.8 Groundwater Monitoring

Of the 25 wells originally installed in the vicinity of Waste Area C, 21 have been maintained for groundwater monitoring for the permanent heap leach facility and the Waste Area C Landfill. These wells include both upgradient and downgradient wells and well clusters. Each cluster consists of a shallow well to monitor the water table in the saprolite materials and deeper wells (typically 2) to monitor any deeper fracture systems that may be hydraulically active.

All monitor wells have been constructed and maintained in accordance with R.61-71. Figures 7 and 8 present schematic installation details for the shallow and bedrock monitor wells, respectively. A detailed description of monitoring well construction is presented in Appenidix B of DP Engineering et al. (1990). Table 4 presents a summary of the well depths. The well locations are shown on Figure 4.

TABLE 4
MONITOR WELL DEPTHS, WASTE AREA C

Well Number	Depth	Well Number	Depth
Cluster A		Cluster B	
A1	193 ft	B1	171 ft
A2	143 ft	B2	121 ft
A3	70 ft	Cluster D	
Cluster C		D1	130 ft
C1	182 ft	D2	160 ft
C2	75 ft	D3	79 ft
GW-5	37.8 ft	Cluster F	
Cluster E		F1	205 ft
E1	60 ft	F2	140 ft
E2	300 ft	F3	75 ft
E3	106 ft		
GW-6	28.4 ft	L2	82 ft
		N	27 ft
		O	29 ft

Waste Area C groundwater monitoring data has been collected from these wells on a quarterly basis since September, 1991. This data includes water elevations and the constituents listed in Table 5. The groundwater monitoring data to date is presented in Appendix B. Groundwater levels within the uppermost unconfined aquifer have remained within historical limits measured since the monitoring system has been installed and reflect normal seasonal fluctuations.

TABLE 5
GROUNDWATER MONITORING CONSTITUENTS

Total Dissolved Solids (TDS)	Barium
Total Suspended Solids (TSS)	Cadmium
pH	Calcium
Temperature	Copper
Specific Conductivity	Copper (dissolved)
Total Organic Carbon (TOC)	Iron
Alkalinity	Lead
Ammonia, N	Magnesium
Nitrite, N	Manganese
Nitrate, N	Mercury
Chloride	Nickel
Sulfate	Potassium
Cyanide (total)	Selenium
Aluminum	Sodium
Arsenic	Zinc

4.0 CLOSURE

4.1 Closure Criteria

Closure of the heap as a landfill is proposed by regrading of the surface of the ore piles, preparation of the surface of the heap and placement of a cap or cover.

The final cover of the heap is designed to minimize infiltration and erosion. Infiltration will be minimized through the regrading of the heap and placement of a minimum 2 ft thick low permeability cap. Regrading the heap from its current configuration with 2H:1V overall sideslopes to 3H:1V will also increase the stability of the facility.

The low permeability cap layer will be overlain by 8 to 12 inches of topsoil and revegetated with native grasses to minimize erosion. Erosion will also be minimized through the installation of lateral drainage ditches and a spillway. During closure, runoff from uncapped or newly capped areas will be detained in the solution ponds to allow settling prior to discharge.

4.2 Waste Materials

The waste materials in the permanent heap leach facility/proposed landfill will include unrinsed spent ore, and materials from the decommissioned reusable asphalt leach pad. The waste characteristics of the unrinsed spent ore in the permanent heap leach facility are discussed in Section 3.7. Approximately 60,000 yd^3 of rinsed spent ore from the reusable pad will be placed within the confines of the permanent leach pad. The characteristics of the spent ore from the reusable pad will be similar to the waste characteristics of the spent ore in the permanent heap as discussed in Section 3.7. In addition, the inert asphalt liner and other inert debris from the reusable leach pad will be placed in the permanent leach pad facility.

4.3 Grading and Capping

The ore heap will be regraded to reduce the sideslopes to a maximum slope of 3H:1V and to eliminate irregularities and depressions on the heap surface. Heap regrading will not involve placing any of the waste materials beyond the confines of the leach pad. The existing surface water diversion will be maintained to prevent the ingress of run-off from adjacent areas.

Drawing 14115-002 depicts the initial regraded heap configuration including spent ore and asphalt liner materials from the reusable pad. Following regrading, the surface of the spent ore will be compacted in preparation for capping. Areas containing spent sulfide ore will be overlain by a minimum compacted thickness of 1 ft of spent oxide ore. The permanent heap leach facility/proposed landfill will then be capped with a minimum 2 ft thick layer of fine grained soil having a maximum permeability of 5×10^{-6} cm/sec. This cap layer will be overlain by 8 to 12 inches of topsoil for revegetation with native grasses. The facility will be regraded and capped beginning from the southwest edge working to the northeast.

A QA/QC program will be developed for the installation of the cap material at the leach pad facility. The QA/QC program will identify QA and QC inspectors and contractors along with the testing protocols for the cover installation. Density and permeability testing will be conducted in accordance with industry standards (i.e. ASTM standards) to verify compliance with design specifications.

4.4 Surface Water Management

Due to the inability to rinse the spent ore sufficiently to meet the NPDES permit discharge requirement, any precipitation which comes into contact with the spent ore may require treatment prior to discharge. Therefore, runoff from the uncapped leach pad areas will be tested and detained in the solution ponds for treatment if necessary prior to discharge or discharged directly. Runoff from newly capped areas may contain suspended sediment from the exposed topsoil. If necessary, runoff will be isolated and detained in the solution ponds to allow the sediment to settle from suspension prior to discharge under the provisions of the NPDES permit to Outfall No. 003. As the cap becomes vegetated and fully reclaimed, runoff from the facility will not contain appreciable quantities of sediment and will be discharged directly to Outfall No. 003.

All surface water control facilities have been designed to fully contain the peak run-off from a 100-yr, 24-hr storm event. Runoff hydrographs have been generated through the use of the WASHED computer program developed by Hydrological Systems, Inc. Computer printouts of these hydrographs are contained in Appendix C.

4.4.1 Leachate Collection and Removal

Prior to capping, all direct precipitation on the leach pad will percolate through the spent ore and report to the solution pond system. To facilitate collection and removal of this leachate during and following regrading and capping, additional perforated HDPE drain pipes will be placed along the existing downhill toe of the heap. The newly installed HDPE pipes will be connected to the existing drain pipes daylighting along the toe of the heap. A 2-3 ft drainage blanket of clean sand and gravel will be placed over the drain pipes. Due to the flat grades in this area, the drain pipe spacing will be reduced to limit the average head on the liner to less than 1 ft. The drain pipe will be installed in 9 ft increments in areas where the permeability of the blanket material is on the order of 1×10^{-4} cm/sec. In areas where the blanket material permeability is on the order of 1×10^{-3} cm/sec the drain pipe spacing will be 33 ft. In both cases, the minimum across slope pipe grade will be 0.5 percent. These pipe spacing requirements are based on the results of the HELP Model analyses which will be explained in Section 6.4.

Leachate intercepted by the drain pipes and drainage blanket will initially report to either the pregnant or rinse pond and ultimately to the rinse pond only as the facility is capped. The leachate solution chemistry will be analyzed for compliance with the provisions of the NPDES permit, treated if necessary at the existing water treatment facility, and discharged to Outfall No. 003.

4.4.2 Runoff and Solution Ponds

The existing solution ponds have sufficient capacity to fully contain all runoff from the 100-yr, 24-hr design storm event falling on the leach pad. This 8-inch storm would result in a total runoff volume of approximately 3.5 million gallons from the leach pad. This volume of runoff, plus direct precipitation into the solution ponds, would fill the pregnant and rinse solution ponds to within 2 ft of the pond crests and a portion of the barren pond.

Once 1/3 of the ore heap has been regraded and capped, the current pregnant and rinse ponds can fully contain the 100-yr storm runoff from the exposed portions of the ore heap and direct precipitation into the ponds while still maintaining 2 ft of freeboard. At this time, newly capped areas which have not had ample time for vegetation to become established may result in sediment laden runoff. This runoff will be collected in interception ditches and routed to the existing solution ponds or discharged directly, depending on water quality. Runoff from the capped areas will be isolated from non-capped heap area runoff, and routed to the barren pond or discharged directly via runoff diversion channels as shown on Drawing 14115-002. The barren pond will be isolated from the other two ponds by installing a lined plug in the overflow channels. Prior to isolating this pond for use as a sediment basin, leachate from the Waste Area C Landfill will be routed to the rinse pond.

Once 3/4 of the heap area has been regraded and capped, the rinse pond will have sufficient capacity to contain direct precipitation and runoff from the uncapped portions of the heap, as well as any leachate from capped areas or the Waste Area C Landfill. At this time, both the pregnant and barren ponds will be utilized as sediment basins for runoff from capped areas. The channel directing runoff from the southwest side of the facility will be realigned to discharge into the pregnant pond, which will spill into the barren pond via the existing overflow channel connecting the two ponds. As the northeast side of the heap is regraded and capped, a second channel will direct runoff from this portion of the facility directly into the barren pond.

4.4.3 Lateral Drainage Benches

As shown on Drawing 14115-002, a lateral drainage bench has been included on the sideslopes of the regraded facility to intercept runoff from erosion control. The drainage bench has two distinct segments. The first segment conveys runoff from the northwest, west, and southwest faces of the heap, while the second segment conveys runoff from the southeast face and the northeast "flat" portion of the heap. Both segments of the lateral drainage bench empty into the spillway on the southern portion of the heap as shown on Drawing 14115-002.

The first segment of the lateral drainage bench has a slope which varies from 1 to 7 percent. The minimum flow velocity for runoff arising from the 100-yr, 24-hr storm event when the facility is fully vegetated is 2.8 feet per second (fps), thus the interception ditch will be non-silting. The maximum flow velocity from runoff from the 100-yr, 24-hr storm event when the cap has been placed but vegetation has not been established (worst case) is 9.2 fps, thus a riprap lining will be required for erosion control. The riprap will be used in areas where the slope exceeds 3 percent and will consist of minus 12 inch durable rock and will be placed to the limits indicated on Drawing 14115-002. The recommended riprap and underlying filter gradations are presented in Appendix D. Drawing 14115-003 presents the typical channel details.

The second segment of the lateral drainage bench has a slope which varies from 1.75 to 10.75 percent. The minimum flow velocity for runoff arising from the 100-yr, 24-hr storm event when the facility is fully vegetated is 4.5 fps, thus the interception ditch will be non-silting. The maximum flow velocity for runoff from the 100-yr, 24-hr storm event when the cap has been placed but vegetation has not been established (worst case) is 9 fps, thus a riprap lining will be required for erosion control. The riprap will be placed to the limits indicated on Drawing 14115-002 and will consist of minus 12 inch durable rock. The recommended riprap and underlying filter gradations are presented in Appendix D. Drawing 14115-003 presents the typical channel details.

4.4.4 Runoff Diversion Channels

The runoff diversion channel around the southwest edge of the facility will have a grade of 0.5 to 13.3 percent. The minimum flow velocity in this channel for runoff due to the 100-yr, 24-hr storm event is estimated to be 2.2 fps thus this channel will be non-silting. The maximum flow velocity in the steep segments of this channel from the 100-yr, 24-hr storm event is 8.5 fps and riprap will be utilized to stabilize the channel. This riprap will consist of minus 12 inch diameter durable rock fragments overlying a bedding layer of minus 3/4 inch rock fragments. The limits of riprap lined portions of the channel are shown on Drawing 14115-002. Drawing 14115-003 depicts the typical details of the riprap lining.

The runoff diversion channel around the northeast edge of the facility will have a grade of 0.5 to 20 percent. The minimum flow velocity in this channel for runoff due to the 100-yr, 24-hr storm event is 2.2 fps thus this channel will be non-silting. The maximum flow velocity in the steep channel segments is estimated to be 12 fps and riprap will be utilized to control erosion as per the southwest interceptor. The riprap will consist of minus 18 inch diameter durable rock fragments overlying a bedding layer of minus 1 1/2 inch rock fragments. The approximate limits of riprap lined portions of the channel are shown on Drawing 14115-002.

4.4.5 Spillway Channels

The runoff from the lateral drainage benches and the diversion channels will discharge into a riprap lined "spillway" channel down the face of the facility as shown on Drawing 14115-002. Drawing 14115-003 depicts the channel details. Runoff from the upper surface of the southwest and central portion of the facility will also be routed to this channel by grading the surface and with small berms around the perimeter of the area. Runoff from the upper surface of the northeast portion of the facility will be directed by grading and perimeter berms to the lateral drainage bench, as shown on Drawing 14115-002, and into the spillway channel. The recommended riprap and filter gradations are presented in Appendix D. In lieu of using dumped riprap, grouted riprap may be used in the spillway. The grouted riprap will use smaller diameter rock compared to the dumped riprap.

Each of the surface water diversions will have channels for direct discharge to NPDES Outfall 003 or to the solution ponds. These channels are depicted schematically on Drawing 14115-002. Depending on water quality, the runoff will be discharged directly or routed to the solution ponds. Runoff routing will be controlled by placing sand bags to block the appropriate channels. As the heap is fully reclaimed the surface water diversions will be permanently reconfigured to discharge to natural drainages leading to Outfall No. 003, and the solution ponds will be reclaimed. Drawing 14115-004 depicts the ultimate reclaimed facility plan.

A spillway will also be constructed on the southwest side of the barren pond when this pond is isolated for use as a sediment basin (Drawing 14115-002). This spillway will discharge runoff from the sediment basin, i.e. barren pond, into a natural drainage which ultimately leads to NPDES

Outfall No. 003. The spillway will be lined with riprap or grouted riprap. Typical spillway lining details are depicted on Drawing 14115-003.

4.4.6 Sediment Control

During the regrading and capping operations, Best Management Practices (BMP's) will be employed to contain and control sediment generation at the source. These BMP's will consist of silt fences, hay bale sediment traps, earth dikes, etc. as described in the EPA guidance document "Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices".

Until fully reclaimed, all runoff from capped areas will be detained in the solution ponds to allow the sediment to settle. During periods of wet weather, these ponds will remain full and operate as flow-through sediment basins. If necessary to meet NPDES discharge criteria, flocculent will be added at the ponds to accelerate sediment removal.

4.5 Stability

Regrading the heap from its current configuration with 2H:1V overall sideslopes to 3H:1V will increase the stability of the facility. Although the original heap design (WESTEC 1992a) indicates that the facility would be stable, additional stability analyses were conducted for the facility in its regraded configuration. These analyses utilized the same material properties adopted in the original designs.

The stability analyses employed the PC STABL 5M computer program developed at Purdue University. This program utilizes the Modified Bishop method for satisfying moment equilibrium when evaluating rotational or circular failure surface. The simplified Janbu method is utilized for satisfying force equilibrium when analyzing block or sliding wedge failure surfaces. Janbu's empiricle coefficient for interslice forces can be incorporated with the STABL program. The STABL program incorporates a search routine to locate those failure surfaces with the lowest factor of safety within user defined search limits. Up to 1000 individual failure surfaces can be analyzed in a single run of the STABL program. Successive runs are made to determine the most critical potential failure surface. Computer printouts of the stability analyses for the most critical failure surfaces are contained in Appendix E.

The critical failure surface (i.e. potential failure surface with the lowest factor of safety) consists of a circular or rotational type of failure extending from the crest of the facility to its downslope toe, after passing thorough the foundation soils. This failure surface exhibits a factor of safety of 1.82 under static loading conditions and a pseudostatic factor of safety of 1.29 for a seismic coefficient of 0.10 g. The critical wedge or sliding block failure surface extends from the crest to the toe of the facility and involves basal sliding along the liner interface.

Figure 9 depicts the generalized heap cross-section and summarizes the material properties utilized in the analyses. The critical failure surfaces are also shown on this figure along with a summary of the analysis results.

5.0 RECLAMATION

The reclamation of the heap is discussed in the Barite Hill Project Reclamation Plan Update (Nevada Goldfields 1992). The heap and associated ponds will be revegetated to a grassland standard using a seed mix as recommended by the Cooperative Extension Service, Clemson University or as developed on site. The cap will be revegetated with grasses only, as grasses should not produce roots that could compromise the integrity of the low-permeability cap. The establishment of a vegetative cover will reduce erosion and will provide permanent stability. Mulch will be applied which will prevent erosion as the vegetation becomes established as well as promote vegetative growth. The soils on site will be tested, if necessary, for amendment requirements. The current seed and fertilizer mix being used is as follows:

Seed and Fertilizer Mix		
Seed	Flat Areas (lb/acre)	Sloped Areas (lb/acre)
Cobe Lespedeza	25	50
Fescu	10	20
Bahiagrass	10	20
Rye (Fall/Winter)	10	20
Browntop Millet (Spring/Summer)	10	20
Fertilizer	600	600
Lime	1000	1000
Mulch	1500	1500

This mixture will be planted with a seed drill at the specified rates. Adjustments to the mixtures, or rates will be carried out as experience is gained. Review of the mixture, topsoil, and slope characteristics will be ongoing and will be adjusted as needed.

The planting will be done as the area is prepared. As required, the revegetated areas will be top-dressed in late winter to provide for spring growth.

6.0 POST-CLOSURE CARE

Post closure care includes the maintenance of the integrity and effectiveness of the final cover; maintenance and operation of the leachate collection system; and groundwater monitoring. Post-closure care will be conducted for a minimum of 30 years unless information from leachate management and groundwater monitoring is sufficient to determine that the facility will not pose a threat to human health and the environment. In this case, the period of post-closure care may be decreased.

6.1 Facility Contact

The name and address of the organization responsible for post-closure maintenance:

Nevada Goldfields, Inc.
P.O. Box 1510
McCormick, South Carolina 29835
(803) 443-2222

6.2 Post-Closure Land Use

The goal of the reclamation planning for the Barite Hill Mine is to stabilize disturbed areas and to restore the site to a productive and self-sustaining vegetation cover. Following completion of the mining project, the proposed land use of the project site is grassland with areas of wetlands. This land use will not disturb the integrity of the containment system of the closed heap leach facility or the function of the post-closure monitoring systems.

6.3 Monitoring and Maintenance

The monitoring and maintenance of the final cover is discussed in the Barite Hill Project Reclamation Plan Update (Nevada Goldfields 1992). Periodic monitoring will be implemented to verify that the integrity of the final cover is maintained. Monitoring will provide that the drainages are operational and adequate, that sediment control structures are maintained and operational, and that the vegetative ground cover is returning as prescribed.

To allow for a good stand of vegetation to become established, the revegetated area will be protected throughout the first and second growing season. The vegetation will be monitored in the spring and all of the first growing season to determine plant germination and growth success. If necessary, remedial measures such as reseeding, additional fertilization, and weed suppression will be employed. Since most of the precipitation is lost due to evapotranspiration, runoff and drainage, there should be little moisture remaining to promote the growth of invading plant species, such as trees, whose roots could compromise the integrity of the low-permeability cap. At the end of the second growing season, the vegetation will be surveyed to ensure that there is at least a 75 percent ground cover, and no large bare spots exit.

As vegetation is becoming established, additional monitoring will be necessary following intense or long duration storm events. After storm events, all erosion control features, (runoff diversion channels, lateral drainage benches and the spillway channel), culverts, roads, etc. and the ponds will be inspected and any damaged or affected features repaired immediately. The channels, benches and the pond will also be inspected for excess sediment accumulations. Periodic removal of accumulated sediment will be undertaken on an as-needed basis. Excavated sediment will be stored in a suitable area adjacent to the ponds for future reclamation.

After the vegetation is well established, the sediment basins will no longer be required and runoff from the facility will be directed into the natural drainage to the south of the leach pad. The sediment basins will be reclaimed by folding in and burying the synthetic liner. Sediment that has been removed from the basins and stored will be used as backfill for the ponds as well as the berms creating the southwest side of the ponds. The pond area will be regraded to achieve a natural appearance and revegetated. The heap will continue to be periodically inspected for settlement which could create ponding of surface water upon the waste or affect leachate drainage. Also, the heap embankments, channels, benches, and spillway will be periodically inspected for slope stability.

6.4 Leachate Management

6.4.1 Leachate Quantity

The HELP (Hydrological Evaluation of Landfill Performance) Model developed by the EPA was utilized to evaluate infiltration through the heap cap and the subsequent long term leachate generation. Computer printouts of the HELP model analysis for the proposed landfill cap are contained in Appendix F.

Laboratory testing was completed for samples of potential saprolitic, soil capping material obtained in January 1995 from the anticipated borrow source adjacent to the main pit. Test results indicate permeabilities which range from 1.4×10^{-6} to 3.9×10^{-6} cm/sec when compacted to 95 percent of maximum Proctor density (4 tests). These test results indicate that the material would be suitable for an industrial landfill cap. Laboratory test results for a sample of spent ore indicates a permeability which is on the order of 1.2 x 10^{-6} cm/sec when compacted. The above-referenced laboratory test results are included as Appendix G.

For the HELP Model analysis, the cap was conservatively assumed to consist of two feet of saprolite, (permeability 5 x 10^{-6} cm/sec) overlying one foot of compacted ore, (permeability 5 x 10^{-6} cm/sec). A 12 inch layer of topsoil which has been revegetated with a good cover of grasses was included in the model. The HELP Model computer simulation was run for a period of 20 years to indicate long term conditions. Following stabilization to "steady state" conditions, the model indicates that the average annual leachate reporting from the base of the heap is approximately 9 inches. Nine inches of leachate is 19 percent of the average annual precipitation and equates to an average flow rate of 7.7 gallons per minute (gpm). Short duration peaks from the heap for the steady state condition under this capping scenario occur, however, these flow rates do not last long. The maximum monthly average leachate rate for the steady state condition is 12.2 gpm while the minimum monthly average is 2.0 gpm.

6.4.2 Leachate Quality

The quality of the leachate will be monitored following closure. If the leachate meets the water quality criteria of the site NPDES permit, it will be discharged in accordance with the permit requirements. If the leachate exceeds the NPDES permit water quality requirements, it will be collected and treated until permit discharge requirements are met.

In the event treatment is required, an analysis of treatment options will be conducted and a treatment plan submitted to DHEC. Treatment options will depend on the total flow rate of the leachate and leachate quality. Treatment alternatives may include a passive wetland system, anoxic or aerobic limestone drains, or chemical treatment. The treatment plan will also include disposal options for the sludge which may be generated from the treatment process and closure of the leachate collection pond, i.e. rinse pond.

6.5 Seepage Potential

The facility was fully lined with a composite liner system to contain the leach process solutions during operations. Capping the heap with a low permeability soil liner will substantially reduce the amount of solution percolating through the heap, thus reducing the level of solution buildup or head on the liner system. This will significantly reduce the potential for seepage from the facility and groundwater impacts.

6.6 Groundwater Monitoring

6.6.1 Groundwater Monitoring and Detection Program

Section 3.8 describes the current groundwater monitoring and detection monitoring program for Waste Area C. This program was used during operations of the permanent heap leach facility which is located within Waste Area C. The groundwater monitoring and detection monitoring program is identical to the groundwater monitoring and detection monitoring program for the Waste Area C Landfill, as required in Conditions 7 and 8 of Permit IWP-242. As a result, the current program will function as the permanent heap leach facility/proposed landfill groundwater monitoring and detection monitoring program during closure and post-closure. The groundwater monitoring system and detection monitoring program for Waste Area C Landfill is contained in Appendix H.

Groundwater quality in the upgradient and downgradient wells in the uppermost aquifer at the facility will be monitored for a period of thirty years. After five years of post closure monitoring, NGI will petition DHEC to terminate or modify post closure monitoring if the study of the site hydrology and groundwater quality shows justification.

Results of the groundwater monitoring program will be submitted to DHEC in accordance with the following schedule:

Sampling Quarter	Sampling Period	Results to DHEC
1st	January-February	April 15
2nd	April-May	July 15
3rd	July-August	October 15
4th	October-November	January 15

A quarterly report containing all water quality data and statistical analyses will be submitted to DHEC as specified in the schedule above. An annual report will be submitted with the fourth quarter report summarizing the quarterly determinations of groundwater flow direction and rate. This report will include determination as to whether the monitoring well network continues to meet the requirements of a detection monitoring program.

6.6.2 Groundwater Monitoring Sampling and Analysis Plan

A sampling and analysis plan for the groundwater monitoring and detection monitoring has been developed for the Barite Hill Mine. The sampling and analysis plan contains sampling and analysis procedures that are designated to ensure that the groundwater samples taken are representative; that no contamination is introduced into the groundwater by the sampling procedures; and that the analytical results are accurate.

The sampling and analysis plan includes procedures for:

- Equipment/site preparation;
- Calculation of amount of water to be evacuated prior to sampling;
- Pumping wells and sample collection;
- Quality control samples;
- Interim sample storage;
- Field measurements;
- Chain of custody; and
- Shipment.

The Barite Hill Mine sampling and analysis plan will be used for the groundwater monitoring and detection monitoring program for Waste Area C. The plan is presented in Appendix H.

6.7 Technical Specifications

Technical Specifications for closure of the permanent heap leach facility as an industrial waste landfill are contained in Appendix I.

7.0 FINANCIAL ASSURANCE

In 1990, a surety bond in the amount of $190,000 served as the reclamation bond for the mining operation. In 1991, mining permit Modification 91-1 was approved which allowed for a second lift to be stacked onto the asphalt leach pad on a temporary basis while constructing the dedicated leach pad. The 1990 surety bond was not increased as a result of mine permit Modification 91-1.

NGI filed a plan for the reclamation of the Barite Hill mine in January of 1992. The 1992 plan included estimated costs for each reclamation activity defined by the plan. In July of 1992, Modification 92-1 was approved to construct the permanent leach pad in Waste Area C. The bond was increased to $385,000 in 1992 as a result of mining permit Modification 92-1.

In 1994, the reclamation bond was increased to $1,200,000 as a result of Modification 94-1. Mine permit Modification 94-1 was required to add the Rainsford Pit Extension (2.7 acres), Red Hill East Pit (4.6 acres) and storage pond to the mine site. The 1994 surety bond does not cover costs associated with low-permeability cap installation, lateral drainage construction or spillway construction, for closure of the permanent heap leach facility. Other costs excluded from the 1994 surety bond include post-closure care and maintenance costs of the permanent heap leach facility.

8.0 REFERENCES CITED

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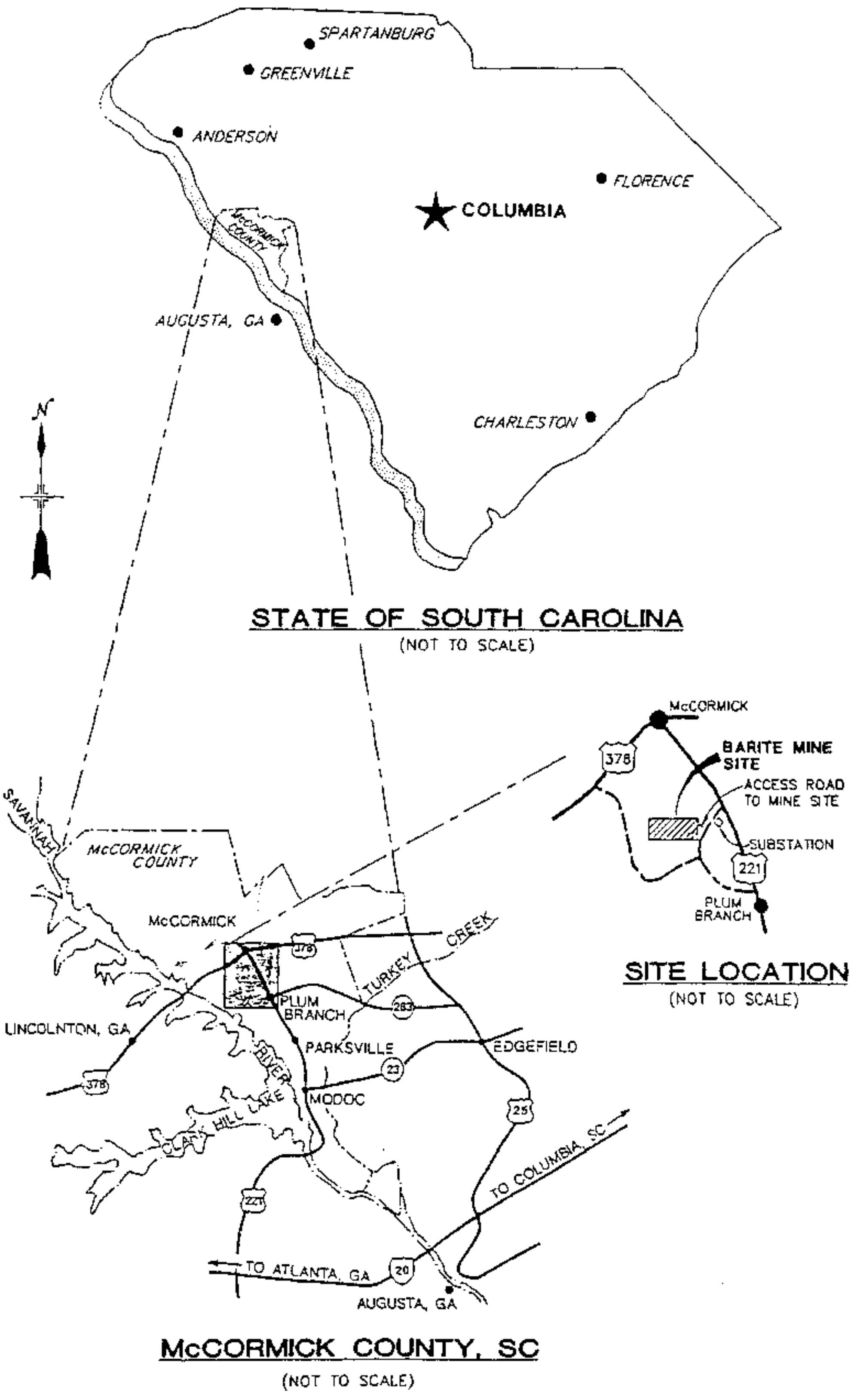


REFERENCE:
AFTER DRAWING TITLED, "VICINITY MAP",
BY WESTEC, FIGURE 1.1. DATED: 12/91.

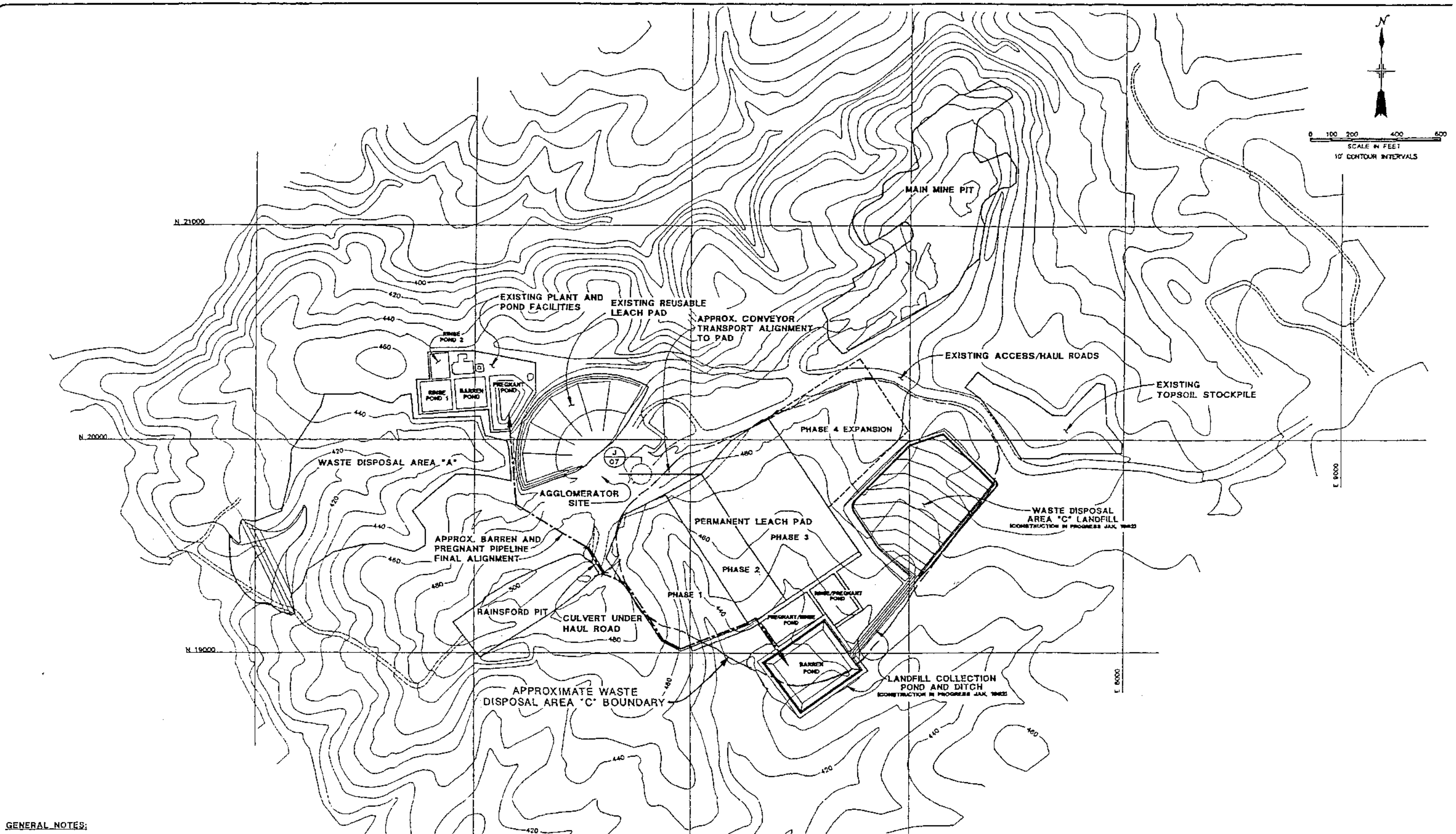
SRK
STEFFEN ROBERTSON & KIRSTEN (U.S.)
Consulting Engineers & Scientists

PROJECT NO.	DATE	REVISION
14115	04/95	A

FIGURE I

VICINITY MAP

* STA.#2 * F:\BARITE\14115\VICMAP.DWG * APR 17, 1995 * 10:33:35 AM *



GENERAL NOTES:

1) GENERAL MINE FACILITIES PLAN AND TOPOGRAPHY WERE PROVIDED BY NEVADA GOLDFIELDS INC.
2) WASTE DISPOSAL AREA "C" LANDFILL AND COLLECTION POND WILL BE CONSTRUCTED IN JANUARY 1992 AND ARE SHOWN FOR REFERENCE PURPOSES ONLY.
3) PERMANENT PAD PHASES 1, 2 AND 3 TO STORE 1.4 MILLION TONS ORE WITH PHASE 4 EXPANSION TO 1.9 MILLION TONS, AS NEEDED.

REFERENCE:
AFTER DRAWING TITLED, "GENERAL MINE FACILITIES LAYOUT", BY WESTEC, DRAWING 03110-02, DATED: 12/91.

SRK
STEFFEN ROBERTSON & KIRSTEN (U.S.)
Consulting Engineers & Scientists

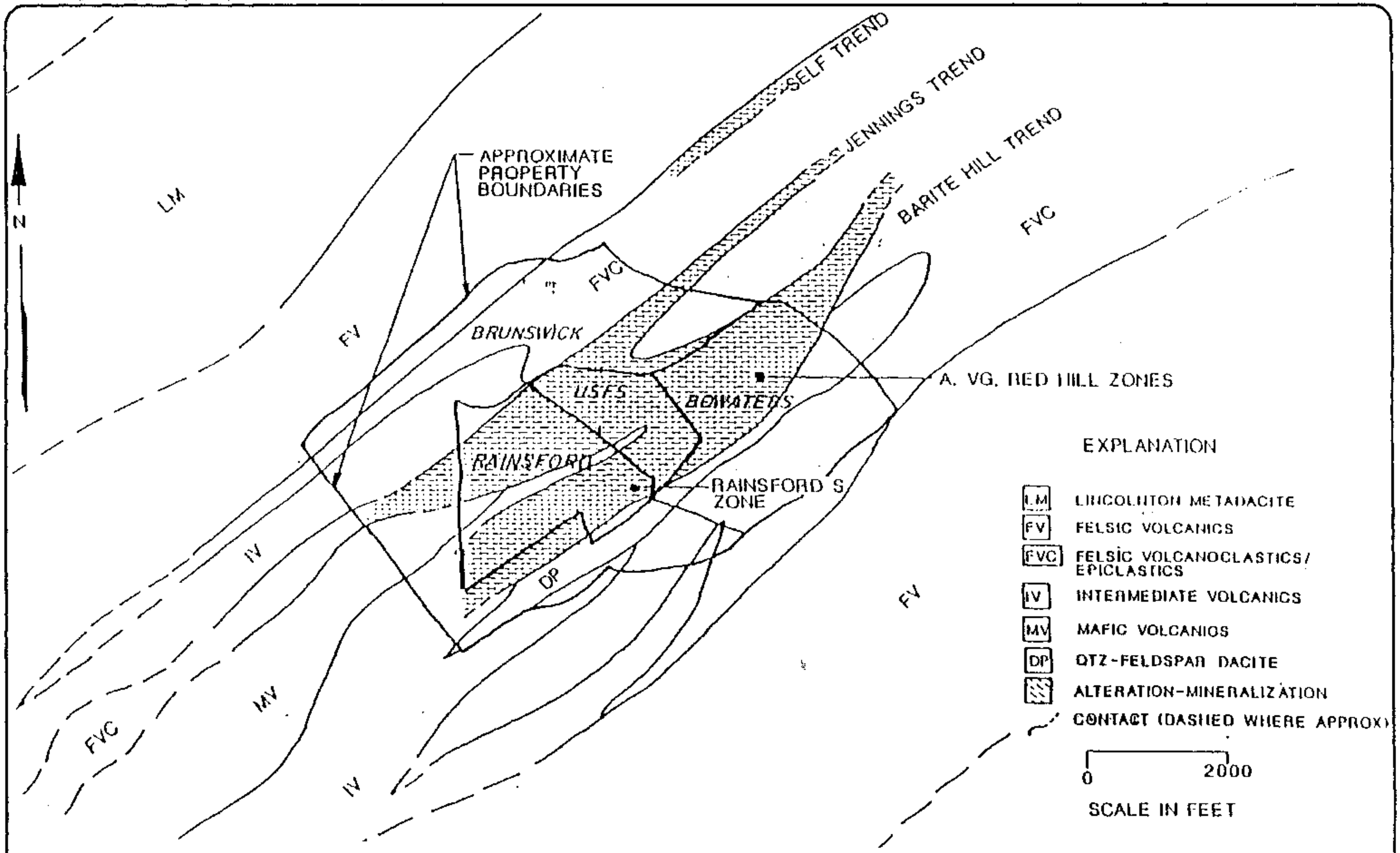
PROJECT NO.	DATE	REVISION
14115	04/95	A

FIGURE 2

GENERAL MINE FACILITIES LAYOUT

• STA_#2 • F:\BARITE\14115\FACLAY.DWG • APR 17, 1995 • 11:10:41 AM •

• STA.#2 • F:\BARITE\14115\GEOLOGY.DWG • APR 17, 1995 • 11:14:39 AM •



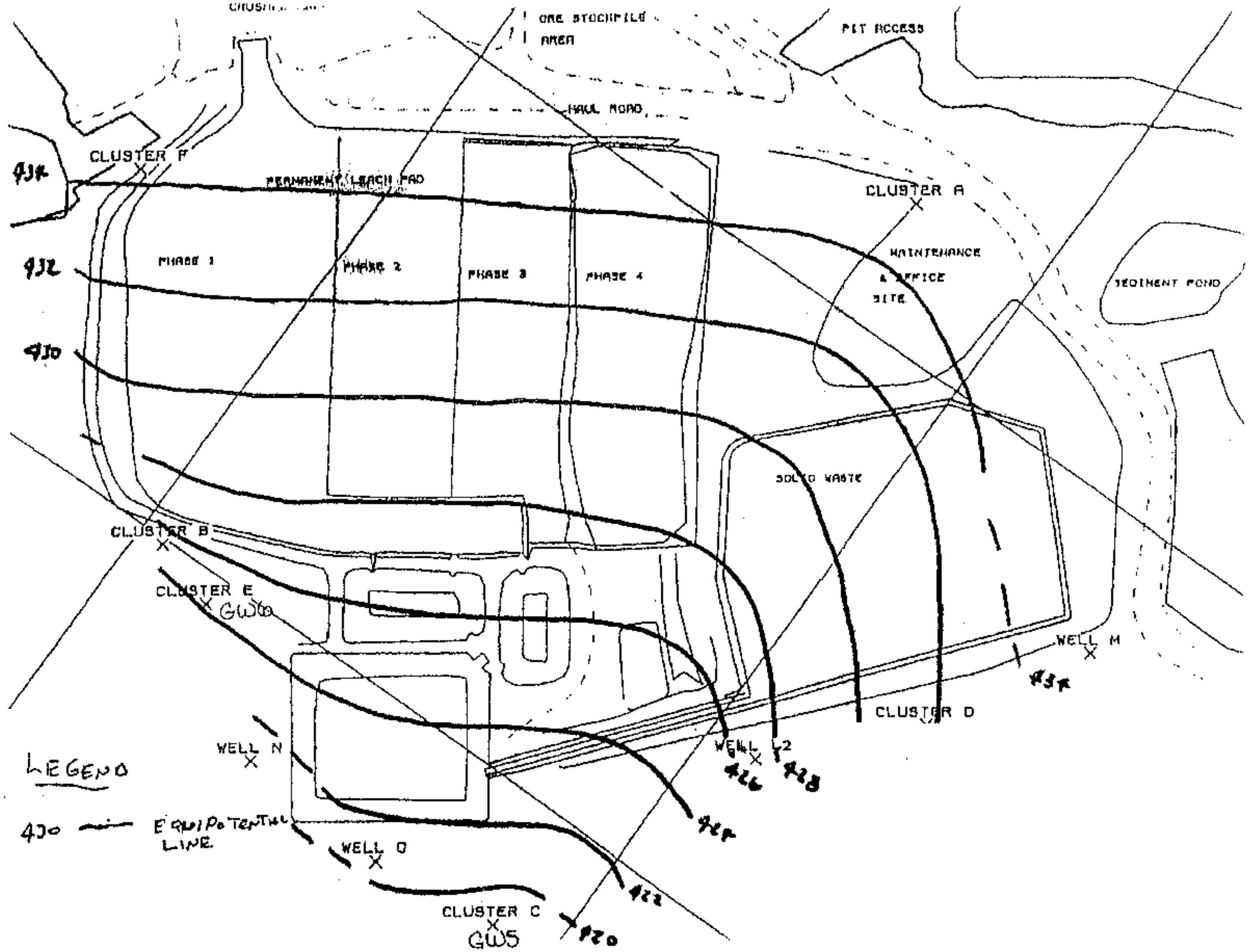
REFERENCE:
AFTER DRAWING TITLED, "GEOLOGY OF THE BARITE HILL AREA", BY WATER, WASTE & LAND INC., FIGURE 2.2, DATED: 03/89.

SRK
STEFFEN ROBERTSON & KIRSTEN (U.S.)
Consulting Engineers & Scientists

PROJECT NO.	DATE	REVISION
14115	04/95	A

FIGURE 3

GEOLOGY OF THE BARITE HILL AREA



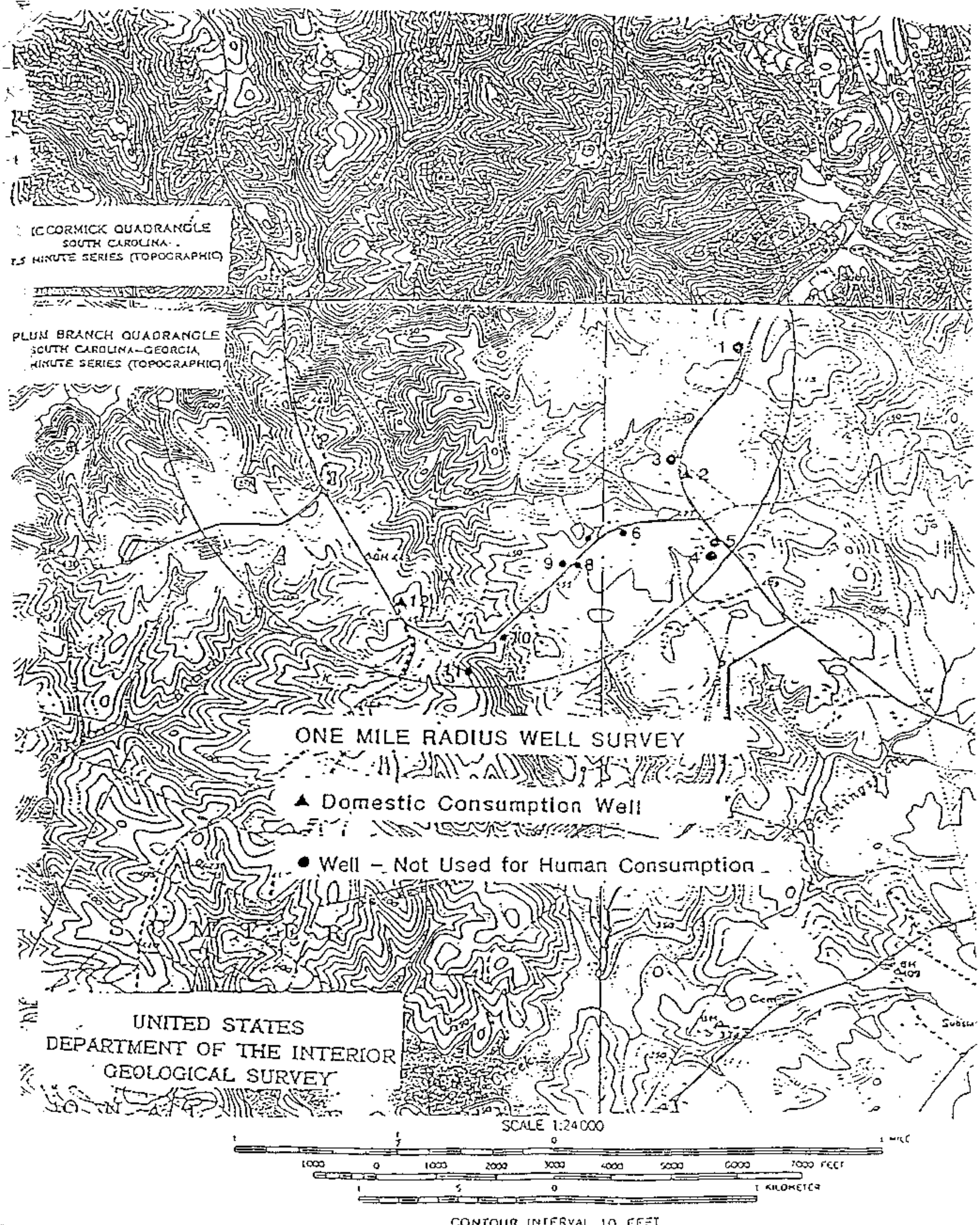
REFERENCE:
AFTER DRAWING TITLED, "POTENTIOMETRIC MAP", BY GAULT GEOLOGICAL SERVICES, FIGURE 2.

SRK
STEFFEN ROBERTSON & KIRSTEN (U.S.)
Consulting Engineers & Scientists

PROJECT NO.	DATE	REVISION
14115	04/95	A

FIGURE 4

POTENTIOMETRIC MAP



REFERENCE:
AFTER DRAWING TITLED, "ONE MILE RADIUS WELL SURVEY", BY ENVIRONMENTAL TECHNOLOGY ENGINEERING, INC.

SRK
STEFFEN ROBERTSON & KIRSTEN (U.S.)
Consulting Engineers & Scientists

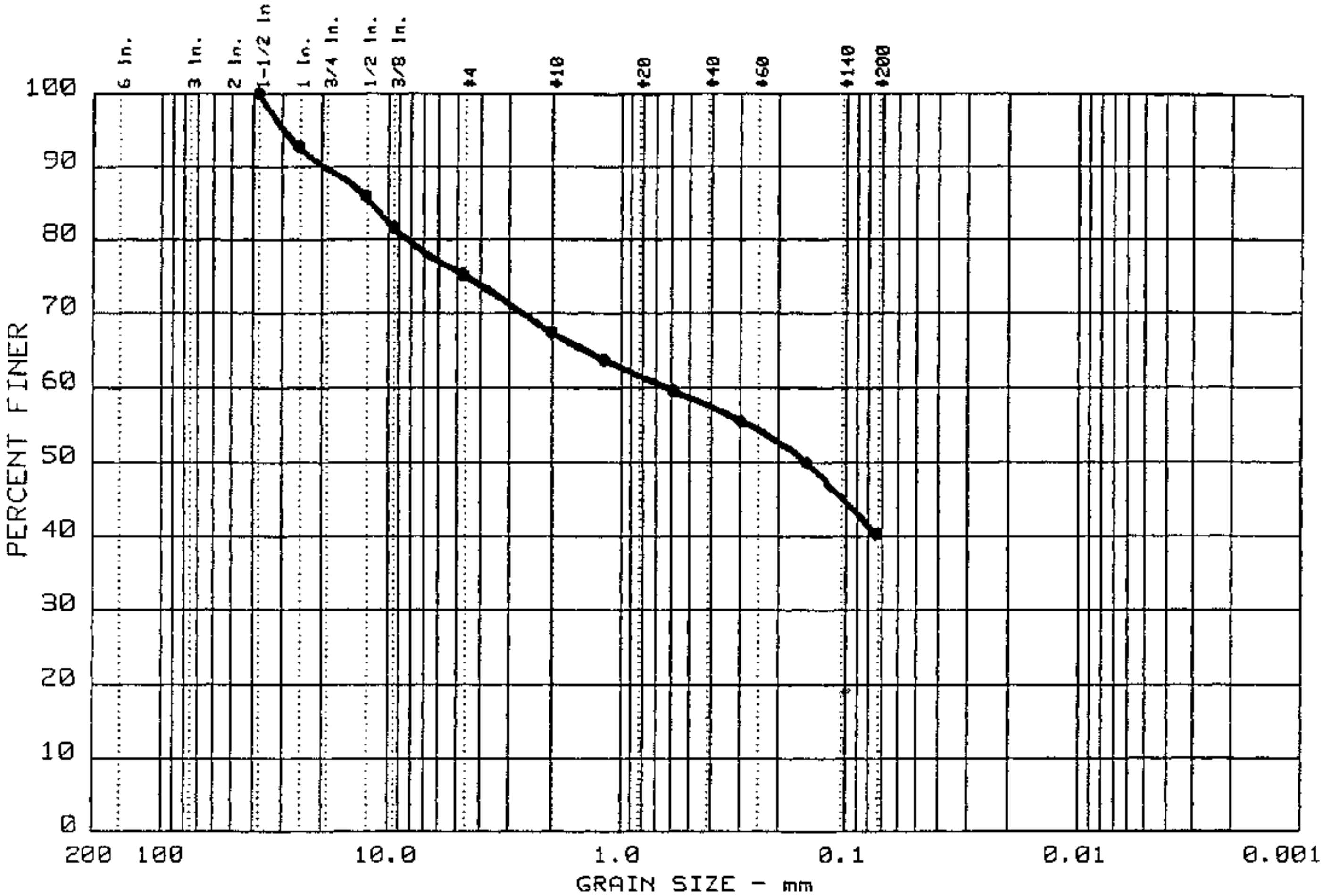
PROJECT NO.	DATE	REVISION
14115	04/95	A

FIGURE 5

ONE MILE RADIUS WELL SURVEY

* STA.#2 * F:\BARITE\14115\ONEMILE.DWG * APR 17, 1995 * 11:22:41 AM *

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% FINES
●	1	0.0	24.8	34.9	40.3

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	22.4	NP	11.89	0.62	0.15					

MATERIAL DESCRIPTION	USCS	AASHTO
● Silty Sand with Gravel	SM	

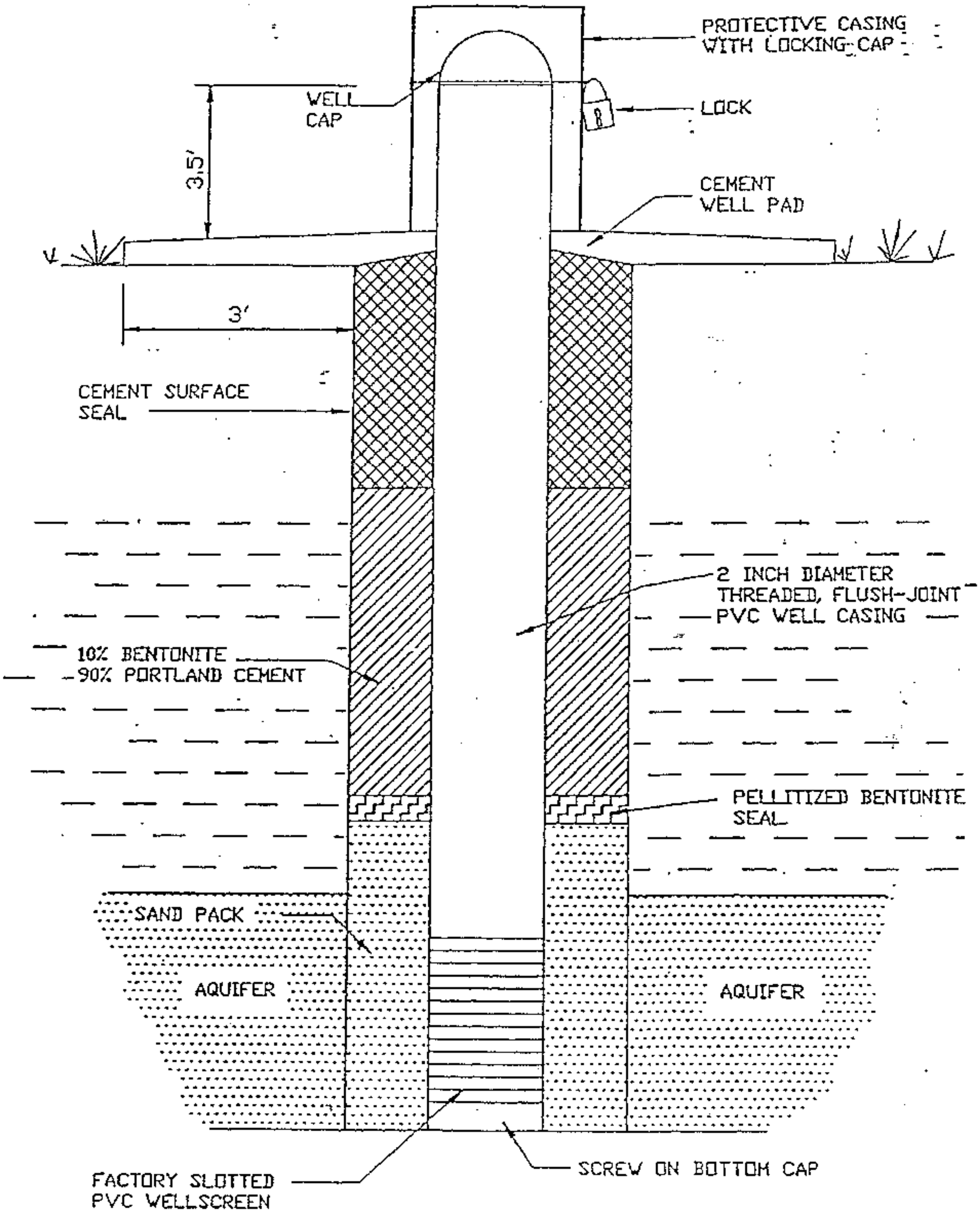
Project No.: 14115
Project: Barite Hill
● Location: Spent Ore

Date: 3/15/95

GRAIN SIZE DISTRIBUTION TEST REPORT
STEFFEN ROBERTSON AND KIRSTEN (U.S.) INC.
Consulting Engineers and Scientists

Remarks:
Max Dry Den = 141.7 pcf
Opt. Moisture = 8.9%

Figure No. 6



GROUNDWATER MONITORING WELL SCHEMATIC

REFERENCE:
AFTER DRAWING TITLED, "GROUNDWATER MONITORING WELL SCHEMATIC", BY ENVIRONMENTAL TECHNOLOGY ENGINEERING, INC.

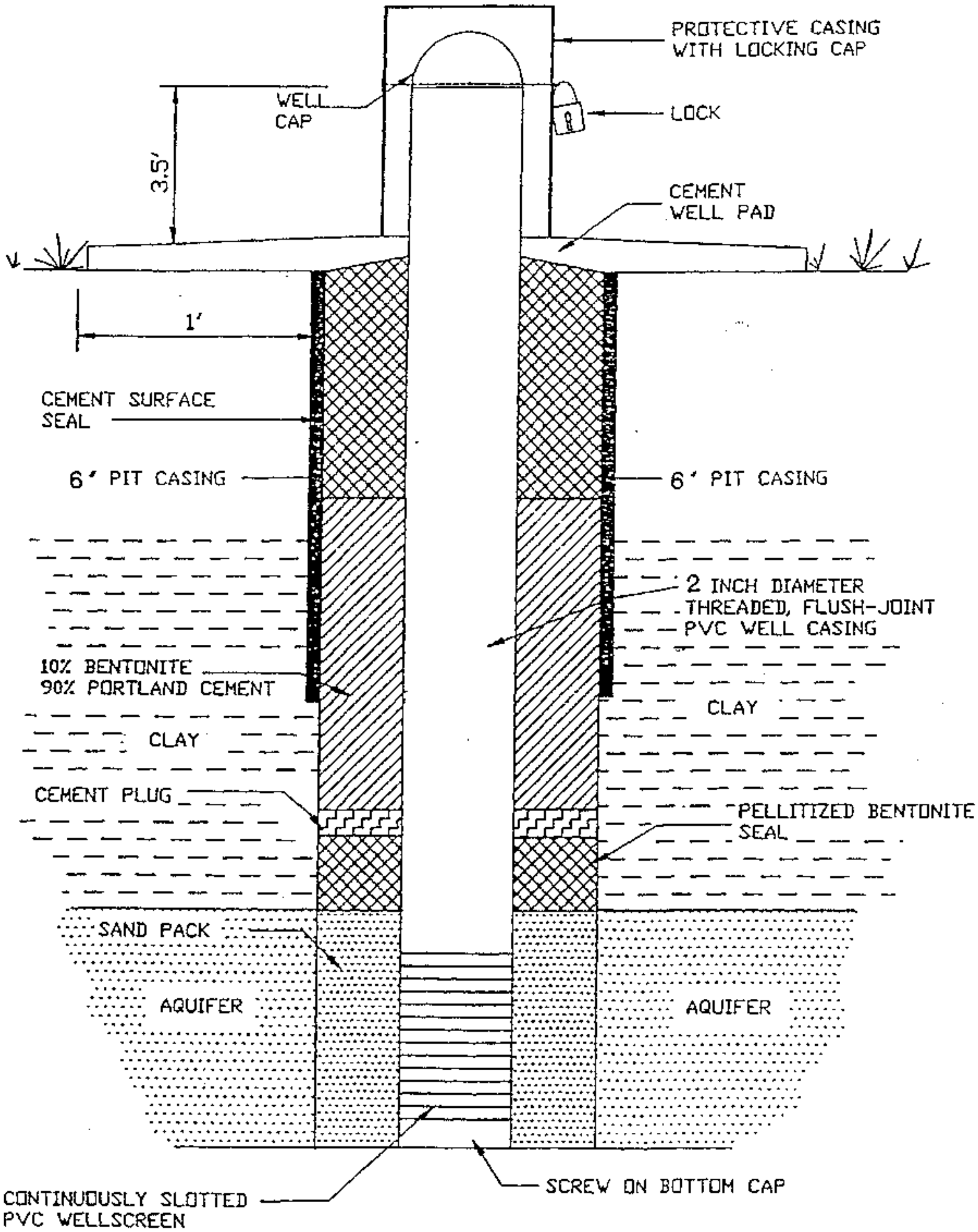
SRK
STEFFEN ROBERTSON & KIRSTEN (U.S.)
Consulting Engineers & Scientists

PROJECT NO.	DATE	REVISION
14115	04/95	A

FIGURE 7

SHALLOW GROUNDWATER MONITORING WELL SCHEMATIC

STA.#2 • F:\BARITE\14115\FIG07.DWG • APR 24, 1995 • 9:23:32 AM •



GROUNDWATER MONITORING WELL SCHEMATIC

REFERENCE:
AFTER DRAWING TITLED, "GROUNDWATER MONITORING WELL SCHEMATIC", BY ENVIRONMENTAL TECHNOLOGY ENGINEERING, INC.

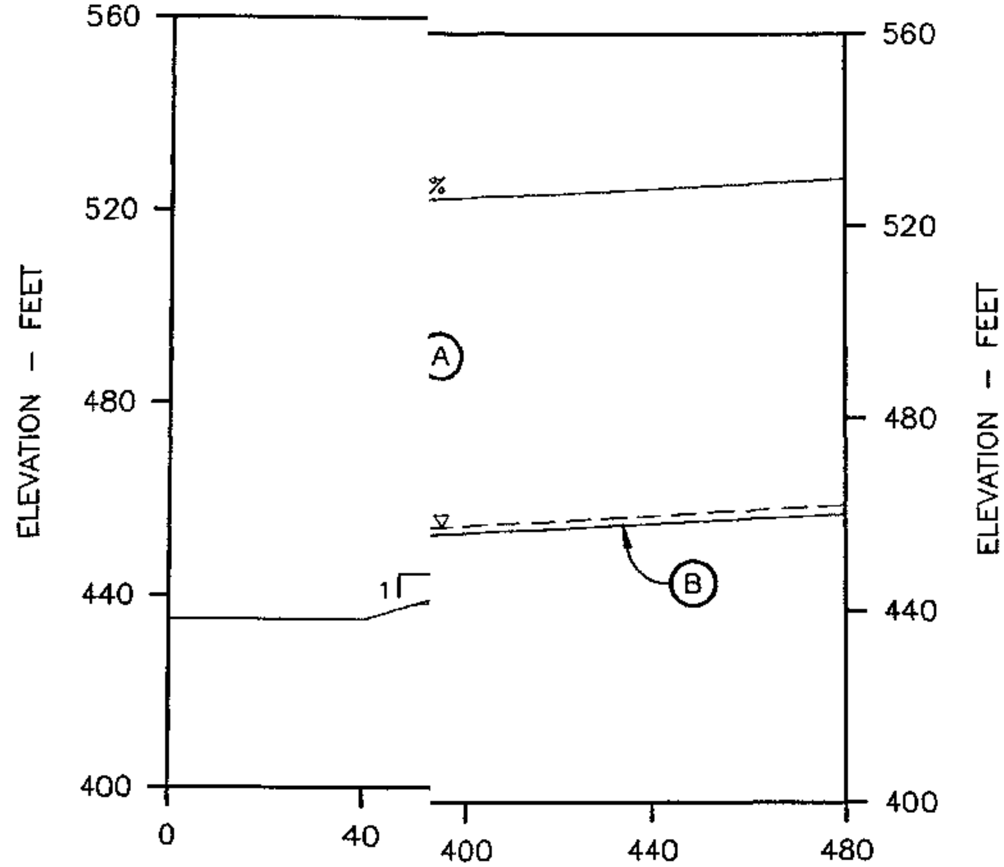
STEFFEN ROBERTSON & KIRSTEN (U.S.)
Consulting Engineers & Scientists

PROJECT NO.	DATE	REVISION
14115	04/95	A

FIGURE 8

DEEP GROUNDWATER
MONITORING WELL SCHEMATIC

* STA.#2 * F:\BARITE\14115\FIG08.DWG * APR 24, 1995 * 9:24:47 AM *



MITY ANALYSIS

MATERIAL TYPE	MA DES
A	
B	
C	
D	NA

TATIC F.O.S.	PSEUDOSTATIC F.O.S. *
.819	1.291
.899	1.539

: F.O.S. ASSUMES A
R ACCELERATION OF 0.1g

FIGURE 9

HEAP STABILITY
ANALYSIS SUMMARY

* STA.#2 * F:\BARITE\14115\FIG09.DWG * APR 25, 1995 * 10:19:31 AM *

APPENDIX A
DHEC APPLICATION FOR PERMIT TO CONSTRUCT A SOLID WASTE MANAGEMENT SYSTEM

South Carolina DHEC Department of Health and Environmental Control

Application for Permit to Construct a Solid Waste Management System
Bureau of Solid & Hazardous Waste Management
(please print or type)

I. Name of project Barite Hill Mine

County: McCormick County

II. Location (street names, etc.): Between U.S. 378 and U.S. 221 off Road 30 in McCormick, South Carolina

III. In accordance with Title 44, Chapter 96 of the Code of Laws of South Carolina, 1976, as amended I hereby make application, on behalf of the owner whose name appears below, for a Permit to Contruct (describe):

An existing permitted permanent heap leach facility as an industrial solid waste landfill. Mining operations have ceased and the heap leach facility is ready for closure. Information on the waste characteristics of the spent ore indicate that rinsing of the heap per permit requirements for cyanide detoxification purposes may increase the potential for acid generation. The design and construction of the heap leach facility was comparable to that of an industrial solid waste landfill.

IV. Owner's name, address: Nevada Goldfields, P.O. Box 1510, McCormick, South Carolina, 29835 Phone Number: (803) 443-2222

V. Name, address of organization responsible for operation and maintenance (if different from owner):

Same as above

Phone Number:

VI. I have placed my signature and seal upon the documents submitted with this application signifying that I accept responsibility for the information and/or design contained therein. Additional submittals where required will also bear by signature and seal, signifying that I accept responsibility for the information and/or design contained therein.

Engineer's name (print): Robert Forey Signature:
Registered Prof. Engineer

STATE OF SOUTH CAROLINA REGISTERED PROFESSIONAL ENGINEER No. 17355 ROBERT C. FOREY 4/25/95

VII. Prior to final approval, I will submit a statement certifying that construction is complete and in accordance with approved plans and specifications, to the best of my knowledge, information and belief. This certification will be based upon periodic observations of construction and a final inspection for design compliance by me or a representative of this office who is under by supervision.

Engineer's name (print): Signature:
Registered Prof. Engineer

VIII. I have read this application and agree to the requirements and conditions that are contained in it. Also, I agree to the admission of properly authorized persons at all reasonable hours for the purpose of sampling and inspection.

Owner's Name (typed): Signature:

Owner's Title: Date:

See other side for instructions on completing this application

APPENDIX B
GROUNDWATER PHYSICAL AND CHEMICAL DATA

monitoring well network. The network continues to meet the conditions of permit Condition 7.

Figure 2 is a equipotential contour map of the groundwater surface in the fourth quarter of 1993, showing the direction of groundwater flow. Note that the sub-430 foot level of groundwater in the pumped out Rainsford Pit causes a slight disturbance in the equipotential surface near the vicinity of the pit.

Sincerely,
Paul C. Rizzo Associates

Howard W. Gault

Howard W. Gault, PG
Project Geologist
South Carolina License No. 1D26

HWG/JAA/dha
Enclosures

PLOT		DRAWN BY	DWD	CHECKED BY			CAD FILE NUMBER	93-1314-A1
1=1			1-28-94	APPROVED BY				

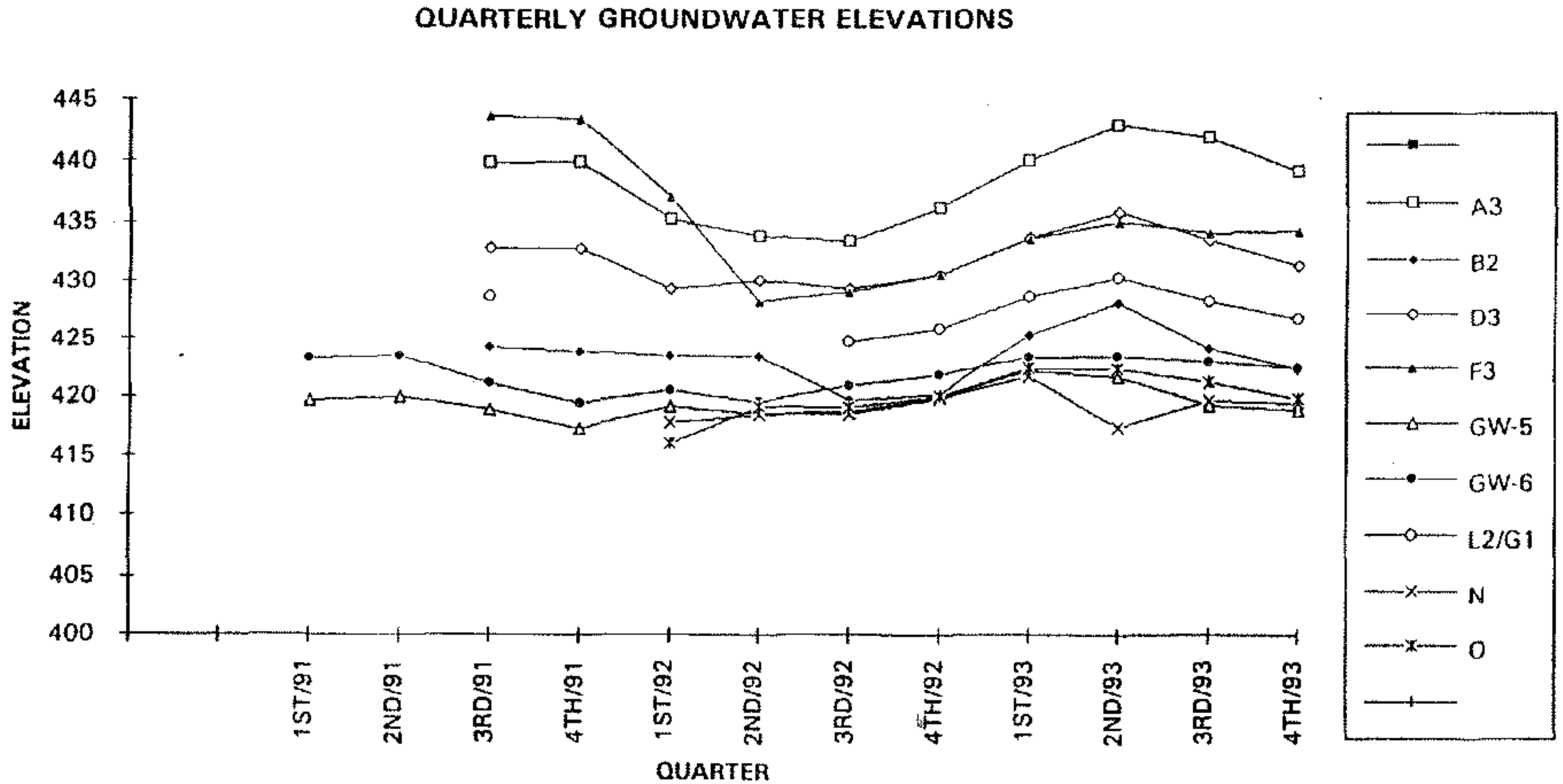


FIGURE 1

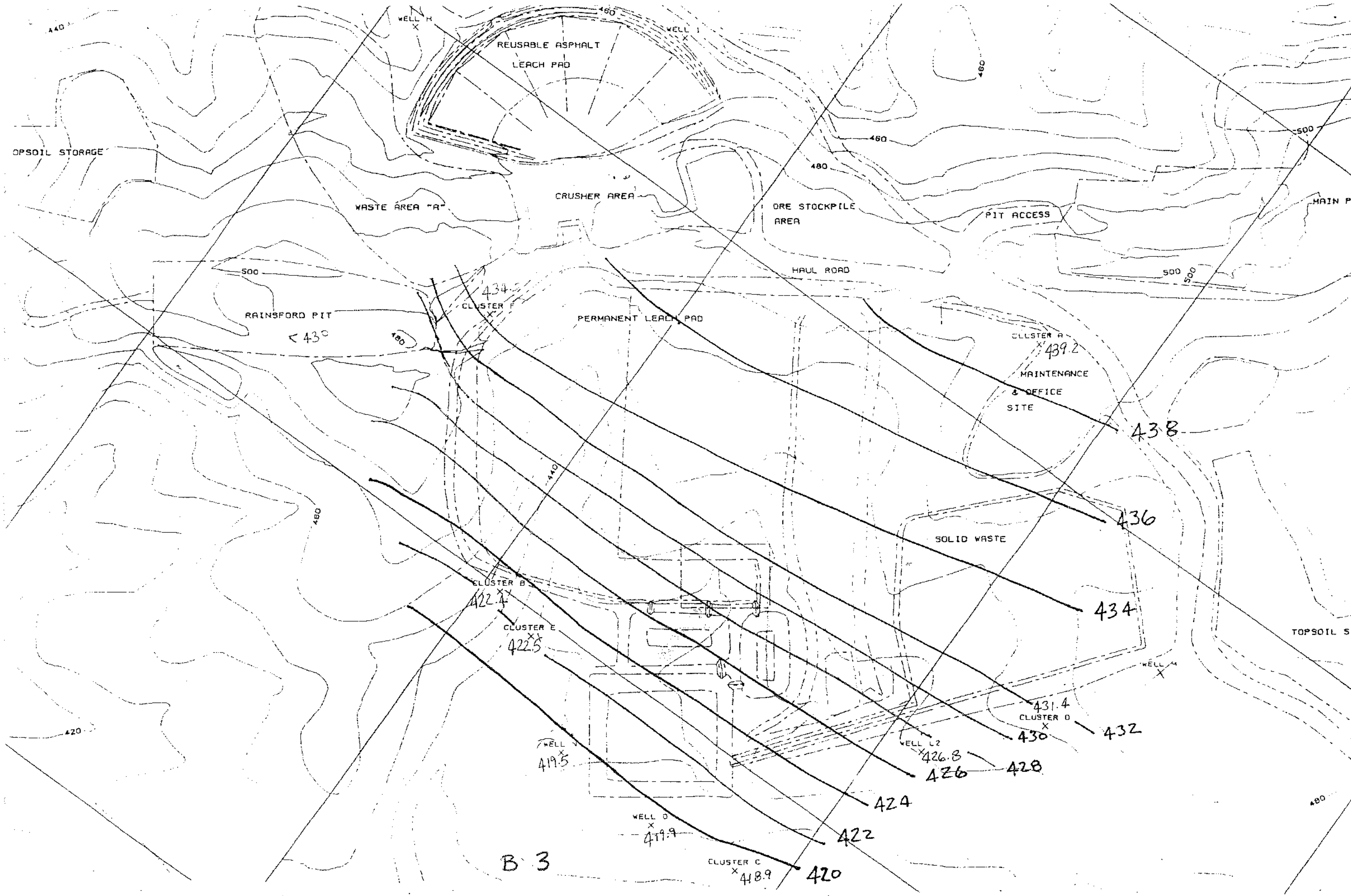
QUARTERLY GROUNDWATER ELEVATIONS
BARITE HILL GOLD MINE
McCORMICK, SOUTH CAROLINA

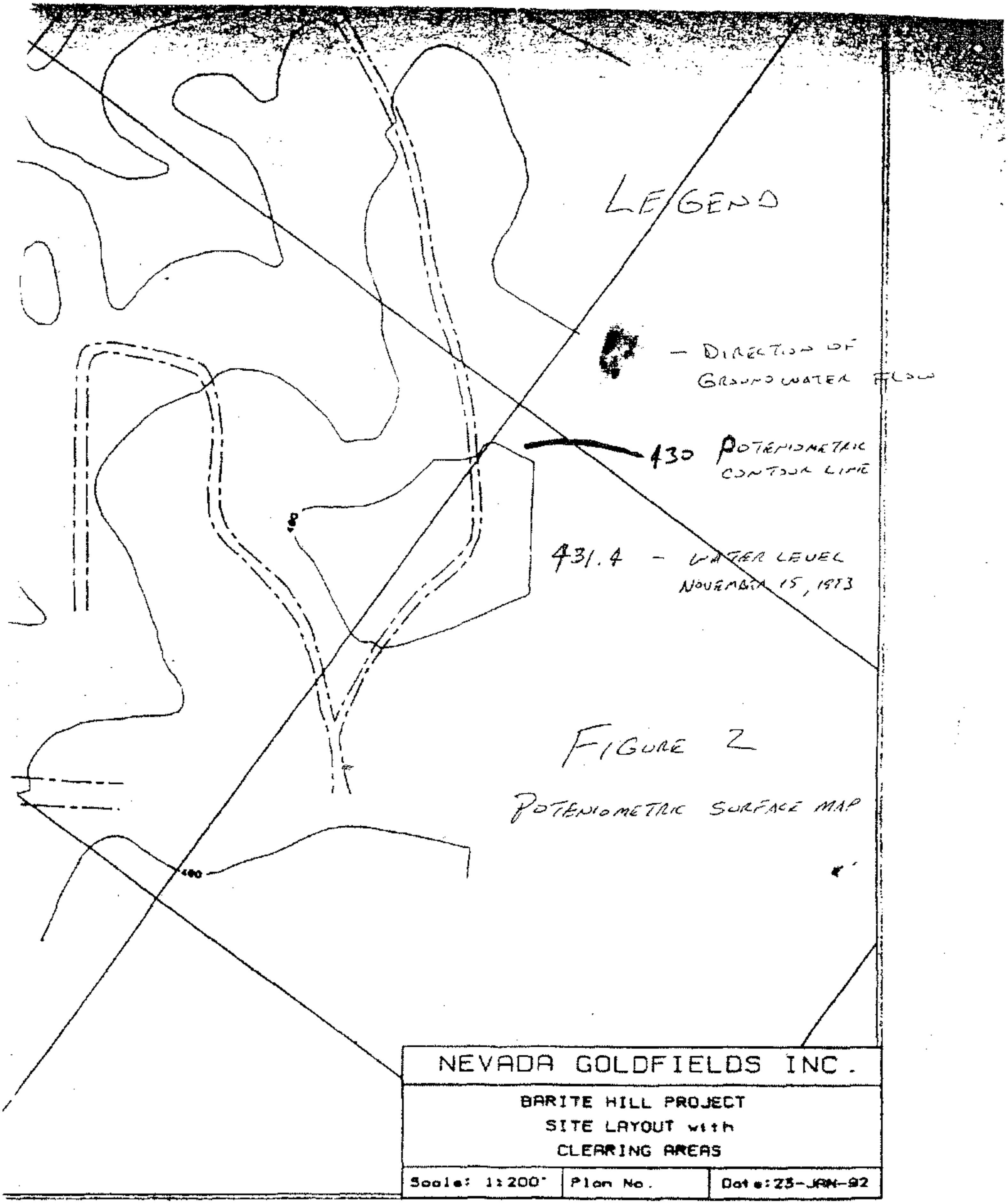
PREPARED FOR

NEVADA GOLDFIELDS INC.
McCORMICK, SOUTH CAROLINA

B 2

Paul C. Rizzo Associates, Inc.
CONSULTANTS


REUSABLE ASPHALT
LEACH PAD
WELL H
WELL I
OPSOIL STORAGE
WASTE AREA "A"
CRUSHER AREA
ORE STOCKPILE
AREA
PIT ACCESS
MAIN PIT
HAUL ROAD
RAINSFORD PIT
< 430
PERMANENT LEACH PAD
434
CLUSTER F
CLUSTER A
439.2
MAINTENANCE
& OFFICE
SITE
438
436
SOLID WASTE
434
CLUSTER B
422.4
CLUSTER E
422.5
TOPSOIL STO
WELL M
431.4
CLUSTER D
432
430
WELL L2
426.8
428
426
WELL J
419.5
424
WELL O
419.9
422
CLUSTER C
418.9
420
B 3
440
460
480
500
420


LEGEND
- DIRECTION OF GROUNDWATER FLOW
430 POTENIOMETRIC CONTOUR LINE
431.4 - WATER LEVEL NOVEMBER 15, 1993
FIGURE 2
POTENIOMETRIC SURFACE MAP
NEVADA GOLDFIELDS INC.
BARITE HILL PROJECT
SITE LAYOUT with
CLEARING AREAS
Scale: 1:200'
Plan No.
Date:23-JAN-92

Paul C. Rizzo Associates, Inc.
CONSULTANTS

April 4, 1994

Project No. 93-1314.01

RECEIVED APR 0 6 1994

Ms. Jean V. Whisnant
Nevada Goldfields, Inc.
Post Office Box 1530
McCormick, SC 29835

FIRST QUARTER 1994 AND ANNUAL SUMMARY
HYDROGEOLOGIC EVALUATION OF GROUNDWATER FLOW AND RATE
BARITE HILL GOLD MINE
MCCORMICK, SOUTH CAROLINA

Dear Ms. Whisnant

Condition 9d of Solid Waste Permit IWP-242 issued by the office of Environmental Quality Control within the Bureau of Solid and Hazardous Management of the Department of Health and Environmental Control requires that a Registered Professional Geologist determine if groundwater monitoring at the Barite Hill Gold Mine complies with the requirements of Condition 7.

I have evaluated the monitoring well data recorded during the first quarter of 1994, as measured on May 18, 1993 and determined that groundwater levels within the uppermost unconfined aquifer are within the historical limits measured over the past three years. All but well A3 show a predictable slight elevation of water levels, due to seasonal fluctuations. Well A3, while still the most upgradient well, may be showing the effects of dewatering of the main pit. The network continues to meet the requirements of Condition 7 in that wells F3 and A3 remain upgradient and the rest of the monitoring system is downgradient.

Sincerely,
Paul C. Rizzo Associates

Howard W. Gault

Howard W. Gault, PG
Project Geologist
South Carolina License No. 1026

HWG/JAA/dha

B5

GAULT
Geological Services
2000 Eden Park Blvd
McKeesport, PA 15132
Phone 412-673-3063
Fax 412-673-4804

July 27, 1994

RECEIVED AUG 0 1 1994

Project No. 94-1001

Ms. Jean V. Whisnant
Nevada Goldfields, Inc.
Post Office Box 1530
McCormick, SC 29835

Second Quarter 1994
Hydrogeologic Evaluation of Groundwater Flow and Rate
Barite Hill Gold Mine
McCormick, South Carolina

Dear Ms. Whisnant:

Condition 9d of Solid Waste Permit IWP-242 issued by the office of Environmental Quality Control within the Bureau of Solid and Hazardous Management of the Department of Health and Environmental Control require that a Registered Professional Geologist determine if the groundwater monitoring at the Barite Hill Gold Mine complies with the requirements of Condition 7.

I have evaluated the monitoring well data recorded during the second quarter of 1994 as measured on May 9,1994 and determined that groundwater levels within the uppermost unconfined aquifer are within the historical limits measured since the monitoring well system has been installed. All but well GW-6 show slight fluctuations relative to the first quarter 1994 data. Well GW-6 shows an unexplained 16.4 foot drop in the elevation of the groundwater since the recording of the first quarter 1994 data. This excessive drop in well GW-6 can not be caused by mining activities because the well is located far away from mining activities. Nevertheless, the well network continues to meet the requirements of condition 7 in that wells F3 and A3 remain upgradient and the rest of the monitoring system is downgradient.

Sincerely,
Gault Geological Services

Howard W Gault

Howard W. Gault, PG
South Carolina License No. 1026

B 6

GAULT
Geological Services

2000 Eden Park Blvd
McKeesport, PA 15132
Phone 412-673-3063
Fax 412-673-4804

RECEIVED OCT 1 4 1994

September 29, 1994

Project No. 94-1001

Ms. Jean V. Whisnant
Nevada Goldfields, Inc.
Post Office Box 1530
McCormick, SC 29835

Third Quarter 1994
Hydrogeologic Evaluation of Groundwater Flow and Rate
Barite Hill Gold Mine
McCormick, South Carolina

Dear Ms. Whisnant:

Condition 9d of Solid Waste Permit IWP-242 issued by the office of Environmental Quality Control within the Bureau of Solid and Hazardous Management of the Department of Health and Environmental Control require that a Registered Professional Geologist determine if the groundwater monitoring at the Barite Hill Gold Mine complies with the requirements of Condition 7.

I have evaluated the monitoring well data recorded during the second quarter of 1994 as measured on August 8,1994 and determined that groundwater levels within the uppermost unconfined aquifer are within the historical limits measured since the monitoring well system has been installed. All show slight fluctuations relative to historical data. Well GW-6, whichshowed an unexplained 16.4 foot drop in the elevation of the groundwater in the second quarter, now exhibts a normal reading. This excessive drop in the well GW-6 ground-water elevation can best be explained as a spurious and likly erronous reading.The well network continues to meet the requirements of condition 7 in that wells F3 and A3 remain upgradient and the rest of the monitoring system is downgradient.

Sincerely,
Gault Geological Services

Howard W. Gault

Howard W. Gault, PG
South Carolina License No. 1026

B7

GAULT
Geological Services

2000 Eden Park Blvd
McKeesport, PA 15132
Phone 412-673-3063
Fax 412-673-4804

March 13, 1995

Project No. 94-1001

Ms. Jean V. Whisnant
Nevada Goldfields, Inc.
Post Office Box 1530
McCormick, SC 29835

Forth Quarter 1994 and Annual Summary
Hydrogeologic Evaluation of Groundwater Flow and Rate
Barite Hill Gold Mine
McCormick, South Carolina

Dear Ms. Whisnant:

Condition 9d of Solid Waste Permit IWP-242 issued by the office of Environmental Quality Control within the Bureau of Solid and Hazardous Management of the Department of Health and Environmental Control require that a Registered Professional Geologist determine if the groundwater monitoring at the Barite Hill Gold Mine complies with the requirements of Condition 7. Additionally, Condition 13c requires that the Forth Quarter Report should include an annual summary, and again, a determination of the compliance with Condition 7 monitoring requirements.

I have evaluated the monitoring well data recorded during the forth quarter of 1994 as measured on November 30, 1994 and January 8, 1994 and determined that groundwater levels within the uppermost unconfined aquifer are within the historical limits measured since the monitoring well system has been installed. All show slight fluctuations relative to historical data. The well network continues to meet the requirements of condition 7 in that wells F3 and A3 remain upgradient and the rest of the monitoring system is downgradient. Now that mining operations have ceased the ground-water flow regime appears to be returning to pre mining conditions. The potentiometric surface is roughly parallel to the land surface as represented by topographic contours.

Seasonal variations during 1994 were within historical fluctuations. The recorded ground-water levels from 1991 through 1994 are presented graphically as Figure 1. The cessation of dewatering and mining in the Rainsford Pit has resulted in a steady increase in water levels in monitoring well F3. Well F3 is now the most upgradient well, thus apparently returning to pre-mining levels. There was an erroneous reading of well GW-6 during the

B 8

second quarter of 1994. This data point will be removed from the data set in the next annual summary as it is certainly spurious data.

The ground-water gradient was 0.011 in the third quarter of 1994 when mining operations reached their maximum. This ground-water gradient compares to a range of gradients of 0.011 in the third quarter of 1992 and 0.015 in the second quarter of 1993. This gradient is within the historical range.

The monitoring well network has always met the requirements of permit Condition 7 as wells A3 and F3 have always upgradient. Figure 2 is a equipotential contour map of the ground-water surface in the third quarter of 1994 when mining operations reached their maximum depth.

Sincerely,
Gault Geological Services

Howard W. Gault
Howard W. Gault, PG
South Carolina License No. 1026

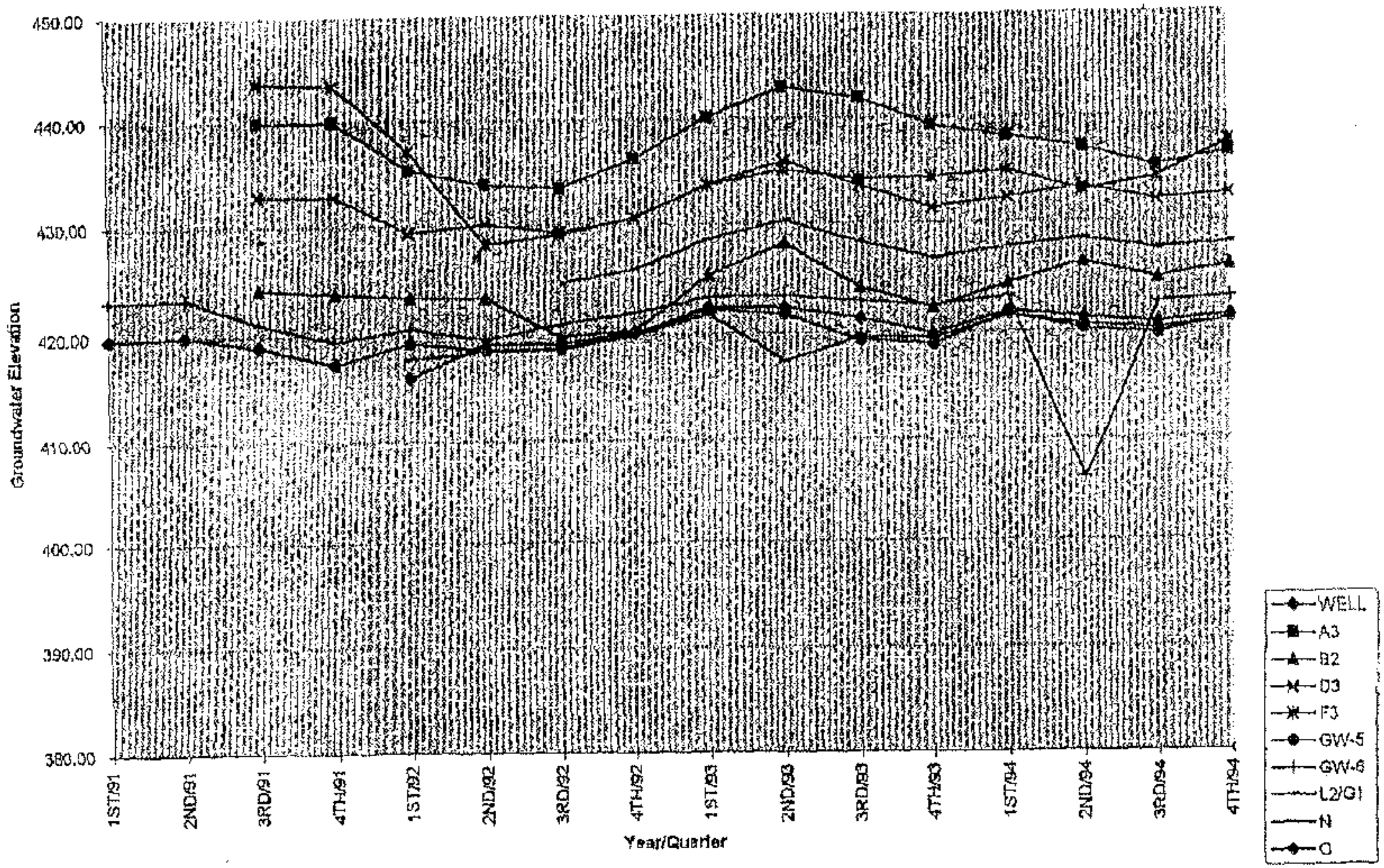


Figure 1
Hydrograph of Ground-Water Levels

B10

Barite Hill Mine
Nevada Gold Fields
McCormick South Carolina

Gault Geological Services

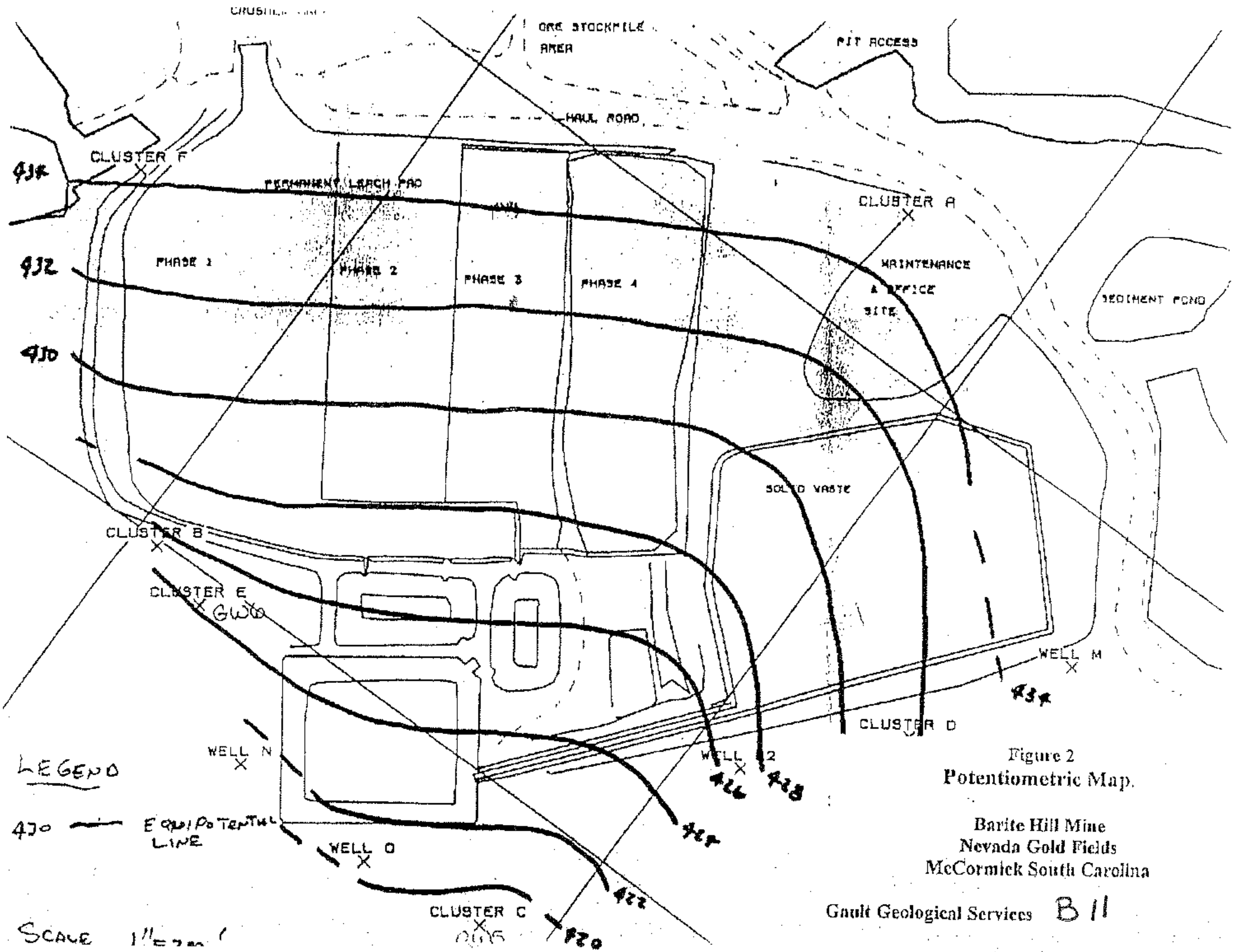


Figure 2
Potentiometric Map.

Barite Hill Mine
Nevada Gold Fields
McCormick South Carolina

Gault Geological Services B 11

DHEC MONITOR WELLS
QUARTERLY REPORTS

1995

A3 & F3 UPGRADIENT

LOCATION 20242.910, 675?.740

COLLAR ELEVATION - 486.100
DEPTH OF WELL - 70ft

* K value used for 25 sample points until a table having a more complete listing is obtained

DEPTH TO WATER WATER ELEVATION	MEAN	COUNT	STD s #	K*	Low Tol	High Tol
Silver	0.0108	30	0.006183	2.63	0	0.027
Aluminum	11.02103	30	15.57689	2.63	0	51.988
Barium	0.164933	30	0.086864	2.63	0	0.393
Calcium	5.406705	17	5.473833	2.95	0	21.55
Cadmium	0.003373	30	0.001984	2.63	0	0.009
Chromium	0.007066	30	0.003903	2.63	0	0.017
Copper	0.126366	30	0.185719	2.63	0	0.615
Copper (Dissolve	0.009	2	0.008485	37.67	0	0.329
Iron	24.3685	30	31.26080	2.63	0	106.58
Potassium	1.403388	18	0.985977	2.95	0	4.31
Magnesium	3.843111	18	11.53629	2.95	0	37.88
Manganese	0.217333	18	0.697776	2.95	0	2.28
Sodium	11.02888	18	4.999919	2.95	0	25.78
Nickel	0.016533	30	0.017801	2.63	0	0.063
Zinc	0.084766	30	0.084973	2.63	0	0.308
Mercury	0.000456	30	0.000470	2.63	0	0.0017
Arsenic	0.0058	30	0.003689	2.63	0	0.016
Lead	0.02456	30	0.028951	2.63	0	0.099
Selenium	0.008	30	0.011416	2.63	0	0.038
TOC	2.386666	30	1.795537	2.63	0	7.11
Alkalinity	27.20555	18	30.03634	2.95	0	115.81
Chloride	7.096666	30	7.278616	2.63	0	26.24
Fluoride	0.185	16	0.130894	2.95	0	0.571
pH (Lab)	5.807142	21	0.494491	2.75	4.45	7.17
pH (Field)	5.3272	25	0.527956	2.63	3.94	6.72
Sulfate	8.22	30	4.266016	2.63	0	19.4
Spec. Cond.	77.37931	29	55.45488	2.63	0	223.2
Temperature	17.21851	27	2.719592	2.63	10.1	24.4
Ammonia N	0.145555	18	0.077855	2.95	0	0.375
Nitrite N	0.05	10	ERR	3.38	ERR	ERR
Nitrate N	0.235833	30	0.080960	2.63	0.024	0.447
Cyanide (total)	0.0058	30	0.002845	2.63	0	0.0133
TDS	61.66666	30	44.27292	2.63	0	178.1
TSS	1026	2	189.5046	37.67	0	8165

B 12

GW-6

B2

LOCATION 18992.210, 60[illegible].990

COLLAR ELEVATION - 446.500
DEPTH OF WELL - 121ft
DATE

DEPTH TO WATER WATER ELEVATION	Mean "X"	Assay Count	Std.Dev. "s"	K value	Tolerance (Low)	Interval (High)
Silver	0.01	15	2.0E-10	2.95	0.010	0.010
Aluminum	1.215266	15	1.673145	2.95	0.00	6.15
Barium	0.1892	15	0.021577	2.95	0.13	0.25
Calcium	34.2	8	3.514053	3.73	21.09	47.31
Cadmium	0.003586	15	0.002142	2.95	0	0.010
Chromium	0.006933	15	0.003918	2.95	0	0.018
Copper	0.018	15	0.011122	2.95	0	0.051
Copper (Dissolved)	0.002					
Iron	11.43333	15	9.949401	2.95	0.00	40.78
Potassium	1.86875	8	0.569145	3.73	0.00	3.99
Magnesium	5.895	8	0.954238	3.73	2.34	9.45
Manganese	0.84475	8	0.524119	3.73	0.00	2.80
Sodium	12.6	8	1.423275	3.73	7.29	17.91
Nickel	0.013733	15	0.007959	2.95	0	0.037
Zinc	0.146933	15	0.088024	2.95	0	0.407
Mercury	0.0002	15	2.0E-12	2.95	0.0002	0.0002
Arsenic	0.005266	15	0.001032	2.95	0.002	0.008
Lead	0.138453	15	0.107571	2.95	0.000	0.456
Selenium X	0.005	15	1.0E-10	2.95	0.005	0.005
TOC	2.08	15	2.068885	2.95	0.00	8.18
Alkalinity	112.625	8	33.81435	3.73	0.00	238.75
Chloride	10.49333	15	2.885546	2.95	1.98	19.01
Fluoride	0.18625	8	0.069475	3.73	0	0.45
pH (Lab)	7.524545	11	0.259359	2.95	6.76	8.29
pH (Field)	7.183333	12	0.537778	2.95	5.60	8.77
Sulfate	10.64	15	2.867502	2.95	2.18	19.10
Spec. Cond.	246.8571	14	45.12522	2.95	113.74	379.98
Temperature	17.20909	11	1.716073	2.95	12.1	22.3
Ammonia N	0.16	8	0.061644	3.73	0	0.390

B 13

N

LOCATION 18757.420, 6358.792

COLLAR ELEVATION - 433.935
DEPTH OF WELL - 27.07
DATE

DEPTH TO WATER WATER ELEVATION	Mean "X"	Assay Count	Std.Dev. "s"	K value	Tolerance (Low)	Interval (High)
Silver	0.010714	14	0.002672	2.95	0.003	0.019
Aluminum	32.21428	14	10.96524	2.95	0.000	64.56
Barium	0.077285 *	14	0.026496	2.95	0.000	0.155
Calcium	31.4125	8	3.051199	3.73	20.03	42.79
Cadmium	0.003657	14	0.001880	2.95	0.000	0.009
Chromium	0.033357	14	0.011297	2.95	0.000	0.067
Copper	0.030857	14	0.012396	2.95	0.000	0.067
Copper (Dissolved)	0.003					
Iron	37.7	14	13.47830	2.95	0.00	77.46
Potassium	3.32875	8	1.885883	3.73	0.00	10.36
Magnesium	37.025	8	6.124132	3.73	14.18	59.87
Manganese	1.774125	8	0.667161	3.73	0.00	4.26
Sodium	45.675	8	4.591840	3.73	28.55	62.80
Nickel	0.022285	14	0.019177	2.95	0	0.079
Zinc	0.354142	14	0.333783	2.95	0	1.339
Mercury	0.0002	14	2.0E-12	2.95	0.0002	0.0002
Arsenic	0.005	14	5.4E-11	2.95	0.005	0.005
Lead	0.007528	14	0.004077	2.95	0.000	0.020
Selenium	0.0125	14	0.011393	2.95	0.000	0.046
TOC	2.028571	14	0.937614	2.95	0.00	4.79
Alkalinity	201.125	8	8.149276	3.73	170.73	231.52
Chloride	61.51428	14	7.217484	2.95	40.22	82.81
Fluoride	0.533333	9	0.257730	3.53	0.00	1.44
pH (Lab)	7.018181	11	0.204930	2.95	6.41	7.62
pH (Field)	6.813333	12	0.304312	2.95	5.92	7.71
Sulfate X	21.64285	14	20.94904	2.95	0.00	83.44
Spec. Cond.	517.8571	14	85.46961	2.95	265.72	769.99
Temperature	16.60769	13	2.705999	2.95	8.62	24.59
Ammonia N	0.1675	8	0.075734	3.73	0.000	0.450
Nitrite N	0.06	5	0.022360	5.08	0.000	0.174
Nitrate N	0.099928	14	0.102582	2.95	0.000	0.403
Cyanide (total)	0.0055	14	0.001344	2.95	0.0015	0.0095
TDS	364.3571	14	228.8494	2.95	0	1039.46
TSS						

B 14

Well O

LOCATION 18758.548, 6704.178

COLLAR ELEVATION - 442.445
DEPTH OF WELL - 28.62
DATE

	Mean "X"	Assay Count	Std.Dev. "s"	K value	Tolerance (Low)	Interval (High)
DEPTH TO WATER						
WATER ELEVATION						
Silver	0.01	13	1.5E-10	2.95	0.010	0.010
Aluminum	9.672307	13	7.051451	2.95	0	30.47408
Barium	0.087384	13	0.081322	2.95	0	0.327
Calcium	32.37142	7	2.943758	4.01	20.57	44.18
Cadmium	0.003161	13	0.002067	2.95	0.000	0.009
Chromium	0.009076	13	0.001656	2.95	0.004	0.014
Copper	0.012769	13	0.007258	2.95	0.000	0.034
Copper (Dissolved)	0.003					
Iron	13.43538	13	8.739462	2.95	0.00	39.22
Potassium	2.43	7	0.726567	4.01	0.00	5.34
Magnesium	19.5	7	4.309679	4.01	2.22	36.78
Manganese	0.332142	7	0.306569	4.01	0	1.56
Sodium	25.65714	7	0.972723	4.01	21.76	29.56
Nickel	0.014	13	0.006964	2.95	0	0.035
Zinc	0.102083	12	0.093066	2.95	0	0.377
Mercury	0.0002	13	ERR	2.95	0.0002	0.0002
Arsenic	0.005	13	7.7E-11	2.95	0.005	0.005
Lead	0.006	13	0.002516	2.95	0.000	0.013
Selenium	0.007692	13	0.005633	2.95	0.000	0.024
TOC	2.341666	12	0.982074	2.95	0.00	5.24
Alkalinity	135.6666	6	5.391351	4.41	111.89	159.44
Chloride	59.85384	13	2.202126	2.95	53.36	66.35
Fluoride	0.268571	7	0.112016	4.01	0.00	0.72
pH (Lab)	6.874444	9	0.250155	3.53	5.99	7.76
pH (Field)	6.6525	12	0.313604	2.95	5.73	7.58
Sulfate X	6.384615	13	3.927222	2.95	0.00	17.97
Spec. Cond.	393.3076	13	91.37047	2.95	123.76	662.85
Temperature	16.64615	13	1.946199	2.95	10.90	22.39
Ammonia N	0.181666	6	0.113563	4.41	0.000	0.682
Nitrite N	0.05	3	ERR	9.92	ERR	ERR
Nitrate N	0.31	12	0.080659	2.95	0.072	0.548
Cyanide (total)	0.005583	12	0.001443	2.95	0.0013	0.0098
TDS	270.2307	13	21.45986	2.95	206.92	333.54
TSS						

B 15

Well L2

LOCATION 19275.583, 2092.098

COLLAR ELEVATION - 462.221
DEPTH OF WELL - 81.91
DATE

DEPTH TO WATER WATER ELEVATION	Mean "X"	Assay Count	Std.Dev. "s"	K value	Tolerance (Low)	Interval (High)
Silver	0.01	15	2.0E-10	2.95	0.010	0.010
Aluminum	27.962	15	55.13759	2.95	0	190.62
Barium	0.056266	15	0.079027	2.94	0	0.289
Calcium	51.9	6	8.801363	4.41	13.09	90.71
Cadmium	0.003506	15	0.002053	2.95	0	0.010
Chromium	0.0294	15	0.047020	2.95	0	0.168
Copper	0.048266	15	0.066392	2.95	0	0.244
Copper (Dissolved)	0.003					
Iron	26.434	15	44.25790	2.95	0	156.99
Potassium	1.502833	6	1.353026	4.41	0	7.47
Magnesium	24.03333	6	8.157859	4.41	0	60.01
Manganese	4.5195	6	4.800167	4.41	0	25.69
Sodium	23.35	6	2.949406	4.41	10.34	36.36
Nickel	0.024733	15	0.014340	2.95	0	0.067
Zinc	0.0836	15	0.063062	2.95	0	0.270
Mercury	0.0002	15	2.0E-12	2.95	0.0002	0.0002
Arsenic	0.005	15	1.0E-10	2.95	0.005	0.005
Lead	0.0086	15	0.007971	2.95	0.000	0.032
Selenium	0.005	15	1.0E-10	2.95	0.005	0.005
TOC	1.94	15	1.476869	2.95	0.00	6.30
Alkalinity	140.3333	6	4.589843	4.41	120.09	160.57
Chloride	78.64666	15	2.960180	2.95	69.91	87.38
Fluoride	0.35	6	0.300599	4.41	0.00	1.68
pH (Lab)	6.774444	9	0.158043	3.53	6.22	7.33
pH (Field)	6.504545	11	0.231705	2.95	5.82	7.19
Sulfate	11.69285	14	15.60988	2.95	0.00	57.74
Spec. Cond.	507.8181	11	43.59774	2.95	379.20	636.43
Temperature	17.37272	11	2.160134	2.95	11.00	23.75
Ammonia N	0.2	6	0.126491	4.41	0.000	0.758
Nitrite N	0.05	2	0.000000	37.67	0.050	0.050
Nitrate N	0.380133	15	0.058891	2.95	0.206	0.554
Cyanide (total)	0.014533	15	0.026308	2.95	0	0.0921
TDS	108.1480	15	101.9083	2.95	0	408.78

B 16

F3 UPGRADIENT F3

LOCATION 19505.080, 5619.790

COLLAR ELEVATION - 482.263
DEPTH OF WELL - 75ft

DATE	8/14/91	8/22/91	2/27/92	5/14/92	8/25/92	duplicate 8/25/92	11/23/92	2/24/93	5/19/93	8/17/93	11/16/93	duplicate 11/16/93	2/14/94	5/9/94
DEPTH TO WATER	38.61	38.82	45.18	53.96	53.19		51.66	48.67	47.22	48.15	47.98		47.45	49.36
WATER ELEVATION	443.653	443.443	437.083	428.303	429.073		430.603	433.593	435.043	434.113	434.283		434.813	432.909
Silver	<0.010	<0.010	<0.010	0.04	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.010	<0.010	<0.010	<0.010
Aluminum	18.2	15	10.9	23.0	20.4	7.1	23.8	8.7	3.74	2.72	2.70	2.03	14.8	7.1
Barium	0.17	0.17	0.15	0.29	0.22	0.13	0.238	0.141	0.115	0.106	0.118	0.117	0.199	0.133
Calcium	8.4	13	5.9	11	11	11	17.4				3.41	1.87		
Cadmium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0021	0.0011	<0.00200	<0.001	<0.0010	<0.001	<0.0050	<0.0050
Chromium	<0.01	0.01	<0.01	0.01	<0.01	<0.01	0.011	0.007	0.002	0.003	0.002	<0.002	0.011	<0.010
Copper	0.14	0.11	0.08	0.28	0.12	0.08	0.193	0.085	0.035	0.026	0.042	0.040	0.335	0.071
Copper (Dissolved)														
Iron	22.9	28	17.4	78.30	35.0	20.8	51.6	22.1	8.94	5.25	9.27	8.24	76.5	18.5
Potassium	3	<2	<2	<2	<2	<2	0.965				0.409	0.455		
Magnesium	1.24	2	1.23	2	2	2	1.71				1.12	1.06		
Manganese	0.05	0.07	0.04	0.08	0.06	0.05	0.059				0.025	0.024		
Sodium	19	15	9	12	13	13	14.6				6.78	6.56		
Nickel	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	0.004	<0.0040	<0.0040	0.005	<0.0040	<0.004	<0.020	<0.020
Zinc	0.21	0.12	0.08	0.12	0.08	0.06	0.082	0.058	0.112	0.052	0.034	0.045	0.097	0.055
Mercury	<0.0002	<0.0002	0.0002	0.0003	0.0003	0.0005	0.0003	0.0003	<0.0002	<0.0002	0.00076	0.00083	0.00083	0.00073
Arsenic	<0.005	0.012	<0.005	<0.005	<0.005	<0.003	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050
Lead	0.026	0.038	0.018	0.12	0.079	0.033	0.079	0.040	0.007	0.015	0.0198	<0.0050	0.0327	0.0169
Selenium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050
TOC	2	<1	2	1	<1	<1	3	3	4	2	5.4	9.6	2.4	1.4
Alkalinity	47	53	21	24	47	26	47.2				9.9	11.0		
Chloride	7	6	7	7	7	7	8	7	8	7	5.9	6.0	5.9	5.4
Fluoride	0.2	<0.1		0.3	0.2	0.2	0.3				<0.10	0.11		
pH (Lab)	6.3	6.19		6.01	6.36	6.16				5.9	6.0	5.9	5.6	5.9
pH (Field)			5.62	5.82	5.47	5.47	5.65	5.58	5.26	5.45	5.44		5.28	6.57
Sulfate X	12	16	10	<12	<12	8	<12	8	9	8	4.7	5.9	<15	7.4
Spec. Cond.	155	110	83	85	121	121	118	94	101	71	63		68	65
Temperature			15.5	20	18	18	16	15	17	22	19.2		16.2	20.5
Ammonia N	0.25	0.13	0.13	<0.1	0.3	0.1	<0.1				<0.10	<0.10		
Nitrite N	<0.05	<0.05	<0.05					<0.05						
Nitrate N	0.12	0.17	0.15	0.17	0.15	0.17	0.17	0.18	0.19	0.19	0.183	0.189	0.127	0.334
Cyanide (total)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.010	<0.006	<0.006	<0.005	<0.0050	<0.0050	<0.0050	<0.0050
TDS	246	20	88	86	113	106	100	51	74	57	48	36	59	40
TSS														

B 17

F3

8/8/94	11/30/94
48.12	44.79
434.143	437.473
<0.010	<0.002
2.84	6.02
0.110	0.105
	1.60
<0.0050	<0.001
<0.010	0.002
0.050	0.062
0.003	
10.6	15.6
	0.592
	0.836
	0.024
	9.70
<0.020	<0.004
0.043	0.036
0.00066	0.00047
<0.0050	<0.0050
0.0061	0.0196
<0.0050	<0.0050
4.5	2.4
	15.8
7.4	7.3
	0.10
6.2	
5.22	6.68
<15	9.6
37	70
17.8	15.1
	<0.10
	<0.050
0.190	0.194
<0.0050	<0.0050
60	46
892	

B 18

QWEC MONITOR WELLS
ARTERLY REPORTS

A3

A3

LC UPGRADIENT

CATION 20242.910, 6753.730

CC

DE LLAR ELEVATION - 486.100
PTH OF WELL - 70ft

DATE	8/28/91	9/12/91	2/27/92	5/14/92	8/25/92	11/23/92	2/24/93	5/19/93	8/17/93	11/15/93	2/14/94	5/9/94	8/8/94	11/30/94
DEPTH TO WATER	46.27	46.18	50.82	52.21	52.65	49.89	46.06	43.14	44.22	46.91	48.06	49.08	50.93	49.64
WATER ELEVATION	439.83	439.92	435.28	433.89	433.45	436.21	440.04	442.96	441.88	439.19	438.04	437.02	435.17	436.46
Silver	<0.01	<0.010	<0.010	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.010	<0.010	<0.002
Aluminum	51	71	16.6	1.9	2.6	2.63	1.16	1.19	0.236	0.501	0.247	4.04	8.17	0.307
Barium	0.53	0.11	0.23	0.11	0.10	0.098	0.129	0.149	0.100	0.130	0.144	0.197	0.274	0.135
Calcium	4		0.6	<1	<1	0.272				0.262				<0.2
Cadmium	0.006	<0.005	<0.005	<0.005	<0.005	<0.001	<0.00100	<0.00100	<0.001	<0.001	<0.0050	<0.0050	<0.0050	<0.001
Chromium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.002	<0.0020	<0.0020	<0.002	<0.002	<0.010	<0.010	<0.010	<0.002
Copper	1	0.06	0.28	0.07	0.04	0.060	0.042	0.042	0.016	0.034	0.031	0.101	0.245	0.021
Copper (Dissolved)													0.015	
Iron	128	95	28.2	5.9	3.0	5.13	2.29	2.11	0.425	1.57	0.609	8.25	20.9	0.671
Potassium	3	<2	2	<2	<2	<0.40				<0.4				<0.4
Magnesium	1	50	0.38	<1	<1	<0.20				<0.2				<0.2
Manganese	0.31	3	0.06	0.02	0.01	0.018				0.009				0.003
Sodium	9	24	8	9	10	11.3				5.45				3.13
Nickel	<0.02	0.10	<0.02	<0.02	<0.02	<0.0040	<0.0040	<0.0040	0.017	<0.004	<0.020	<0.020	<0.020	<0.004
Zinc	0.34	0.38	0.09	0.06	<0.02	0.021	0.020	0.038	0.086	0.027	0.056	0.044	0.061	0.016
Mercury	0.0005	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Arsenic	<0.005	<0.024	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050
Lead	0.076	0.013	0.020	<0.005	0.009	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0069	0.0148	<0.0050
Selenium	<0.05	<0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050
TOC	1	<1	1	2	1	3	1	3	3	1.4	1.6	3.6	2.1	1.2
Alkalinity	14	128	11	12	7.4	11.6				2.8				<1.0
Chloride	5	45	5	5	5	5	5	5	5	4.1	4.0	3.6	3.6	3.7
Fluoride	0.20	0.60		0.1	<0.1	0.1				0.15				<0.10
pH (Lab)	5.64	7.08	5.40	5.46	5.75				5.4	5.3	5.0	5.1	5.3	
pH (Field)			5.40	5.56	5.17	5.27	4.64	4.54	4.81	4.94	4.6	5.16	4.77	4.81
Sulfate	7	<12	4	5	4	4	<3	<3	4	<3.0	<3.0	<15	<12	<3.0
Spec. Cond.	40	310	50	53	61	65	43	41	45	45	46	36	17	30
Temperature	21	8	16.1	18.9	18	16	15	18	19	19.3	16.3	16.4	18.4	14.2
Ammonia N	0.1	0.35	<0.1	<0.1	0.2	<0.1				<0.10				0.16
Nitrite N	<0.05	<0.05	<0.05				<0.05							<0.050
Nitrate N	0.30	0.23	0.25	0.28	0.27	0.29	0.32	0.34	0.27	0.293	0.308	0.485	0.279	0.283
Cyanide (total)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.020	<0.006	<0.006	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050
TDS	116	38	56	42	58	33	17	57	24	32	29	27	50	41
TSS													1160	

B19

12

LOCATION 10992.210, 6023.290 B2

COLLAR ELEVATION - 446.500
DEPTH OF WELL - 121ft

DATE	8/14/91	8/22/91	2/20/92	5/14/92	8/26/92	11/23/92	2/24/93	duplicate 2/24/93	5/18/93	8/17/93	11/15/93	2/14/94	5/3/94	8/8/94	12/8/94
DEPTH TO WATER	22.25	22.59	23	23	26.8	26.19	21.16		18.31	22.35	24.14	22.1	20.16	21.6	20.56
WATER ELEVATION	424.25	423.91	423.5	423.5	419.7	420.31	425.34		428.19	424.15	422.36	424.4	426.34	424.9	425.94
Silver	<0.010	<0.010	<0.010	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.010	<0.010	<0.010
Aluminum	2.0	7	0.2	0.7	0.6	0.669	0.480	0.671	0.639	0.239	0.973	0.880	0.458	1.02	1.70
Barium	0.20	0.25	0.15	0.18	0.20	0.203	0.182	0.184	0.190	0.166	0.181	0.188	0.182	0.187	0.195
Calcium	34.3	40	31.7	31	38	36.1					30.6				31.9
Cadmium	<0.005	0.007	<0.005	<0.005	<0.005	<0.001	<0.00100	<0.00100	<0.0050	<0.001	<0.001	<0.0050	<0.0050	<0.0050	0.0018
Chromium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.0020	<0.0020	<0.0020	<0.010	<0.002	0.002	<0.010	<0.010	<0.010	0.004
Copper	0.02	0.05	<0.02	0.01	0.01	0.009	0.007	0.009	<0.020	0.007	0.021	0.022	0.015	0.021	0.029
Copper (Dissolved)														<0.002	
Iron	11.9	40	0.61	7.7	6.2	7.06	6.10	7.75	7.04	2.51	15.6	13.9	6.93	12.4	25.8
Potassium	3	2	<2	<2	<2	1.30					1.28				1.37
Magnesium	6.29	8	5.16	5	6	5.84					5.37				5.50
Manganese	0.62	2	0.34	0.59	0.60	0.617					0.821				1.17
Sodium	14	15	11	12	13	13.1					11.3				11.4
Nickel	<0.02	<0.02	<0.02	<0.02	<0.02	<0.0040	<0.0040	<0.0040	<0.020	0.006	<0.004	<0.020	<0.020	<0.020	0.004
Zinc	0.31	<0.03	0.04	0.12	0.11	0.094	0.130	0.101	0.153	0.075	0.211	0.201	0.108	0.190	0.331
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020
Arsenic	0.005	0.009	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050
Lead	0.195	0.39	0.009	0.038	0.088	0.094	0.103	0.126	0.070	0.062	0.161	0.165	0.082	0.137	0.357
Selenium X	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050
TOC	<1	8	1	2	1	6	1	2	1	2	1.2	1.3	1.5	1.2	<1
Alkalinity	31	114	124	119	133	126					136				118
Chloride	7	7	8	9	18	15	12	12	10	10	9.9	10.1	9.6	9.8	10.0
Fluoride	0.2	0.2	0.2	0.1	0.1	0.2					0.32				0.17
pH (Lab)	7.1	7.32	7.68	7.78	7.69					7.7	7.6	7.5	7.2	7.3	7.9
pH (Field)			7.64	7.54	7.75	6.83	7.16		7.18	7.43	6.21	6.37	6.72	7.61	7.76
Sulfate	9	10	9	8	9	9	11	11	10	8	19.7	12.1	11.4	12.6	9.8
Spec. Cond.	240	235	267	254	172	310	287		267	266	256	269	245	132	256
Temperature			15	17.8	18	15	15		18		18.9	18	19.6	18.4	15.6
Ammonia N	0.27	0.14	<0.1	<0.1	0.2	0.2					0.17				<0.10
Nitrite N	<0.05	<0.05					<0.05	<0.05							<0.050
Nitrate NX	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	<0.050	0.221	<0.050	0.664
Cyanide (total)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.010	<0.006	<0.006	<0.006	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
TDS	158	14	200	189	220	179	175	173	164	172	192	182	174	161	164
TSS														54	

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2/14/94	5/9/94	8/8/94	8/8/94 duplicate	12/8/94
10.98	12.37	12.79		11.52
421.62	420.23	419.81		421.08
<0.010	<0.010	<0.020	<0.020	<0.010
53.2	37.4	34.1	61.8	89.2
0.240	0.178	0.167	0.255	0.334
				59.4
<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
0.165	0.111	0.098	0.161	0.217
0.141	0.095	0.086	0.132	0.182
		0.004	0.002	
90.6	61.1	54.0	89.7	131
				3.25
				71.4
				3.23
				28.0
0.065	0.037	0.037	0.056	0.074
0.354	0.236	0.185	0.286	0.378
<0.0002	<0.0002	<0.00020	<0.00020	<0.00020
<0.005	<0.005	<0.0050	<0.0050	<0.0050
0.0122	0.0107	0.0086	0.0108	0.0183
<0.005	<0.020	<0.0050	<0.0050	<0.0050
1.3	1.8	1.5	1.8	<1.0
				181
44.1	44.8	44.1	44.8	43.9
				0.13
6.5	6.9	6.8	6.9	6.8
6.33	6.54	6.50	6.54	6.98
<15	<15	<30	<30	<30
447	427	240	249	426
17.2	17.8	18.5	18.5	16.7
				0.34
				<0.050
<0.10	0.258	0.125	0.117	0.125
<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
267	248	244	194	287
		1240	2240	

B 21

03 D -3

LOCATION 19506.650, 7324.42

COLLAR ELEVATION - 470.391
DEPTH OF WELL - 79ft

DATE	8/28/91	9/12/91	2/27/92	5/14/92	8/25/92	11/23/92	2/24/93	5/19/93	8/17/93	11/16/93	2/14/94	5/9/94	8/8/94	11/30/94	duplicate
DEPTH TO WATER	37.54	37.6	41.06	40.24	41.11	39.8	36.72	34.5	36.88	39.05	38.15	37.08	38.39	37.9	
WATER ELEVATION	432.851	432.791	429.331	430.151	429.281	430.591	433.671	435.891	433.511	431.341	432.241	433.311	432.001	432.491	
Silver	0.014	0.061	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.010	<0.010	<0.010	<0.010	<0.002	<0.002
Aluminum	158	62	4.1	1.0	1.6	0.509	0.498	0.351	0.091	0.360	0.926	0.811	2.54	0.644	1.02
Barium	0.21	0.42	<0.02	<0.02	<0.02	0.004	0.007	<0.0040	<0.004	0.008	<0.020	<0.020	<0.020	0.004	0.005
Calcium	85.0		36.2	33	35	33.5				32.7				33.3	32.3
Cadmium	0.007	<0.005	<0.005	<0.005	<0.005	<0.00100	<0.00100	<0.00100	<0.001	<0.001	<0.0050	<0.0050	<0.0050	<0.001	<0.001
Chromium	0.04	<0.01	<0.01	<0.01	<0.01	<0.0020	<0.0020	<0.0020	<0.002	<0.002	<0.010	<0.010	<0.010	<0.002	<0.002
Copper	0.13	0.81	<0.02	<0.01	<0.02	<0.0040	<0.0040	<0.0040	<0.004	<0.004	<0.020	<0.010	0.008	<0.004	<0.004
Copper (Dissolved)													<0.002		
Iron	208	81	5.94	1.2	2.4	0.723	0.638	0.491	0.194	0.830	1.35	1.18	4.05	1.04	1.67
Potassium	6	3	<2	<2	<2	0.454				<0.4				0.528	0.428
Magnesium	87	0.85	15.2	13	14	12.9				13.2				13.1	12.8
Manganese	7	0.18	0.53	0.24	0.41	0.202				0.108				0.157	0.217
Sodium	18	10	19	20	21	20.4				20.1				20.7	19.9
Nickel	0.19	<0.02	0.04	<0.02	0.03	0.023	0.020	0.015	0.021	0.015	0.020	<0.020	0.030	0.015	0.016
Zinc	0.81	0.23	0.04	<0.02	<0.02	0.010	0.014	0.076	0.042	0.019	0.021	<0.020	0.059	0.017	0.013
Mercury	0.0002	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Arsenic	<0.020	<0.020	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.01
Lead	0.025	0.094	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.01
Selenium	<0.10	<0.020	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.01
TOC	1	2	1	1	<1	3	2	2	3	1.9	5.0	3.0	3.3	1.8	3.3
Alkalinity	127	11	129	123	124	127				132				127	126
Chloride	44	5	51	49	47	46	46	46	48	50.9	52.1	50.2	50.1	52.1	52.2
Fluoride	0.75	0.2	1.2	<0.1	0.1	0.1				0.16				0.10	0.13
pH (Lab)	6.85	5.91	6.64	6.67	6.68				6.8	6.8	6.7	6.8	6.8		
pH (Field)			6.68	6.54	5.89	6.60	6.71	6.45	6.43	6.49	6.22		6.34	6.62	6.62
Sulfate	<3	<15	<3	3	<3	<3	<3	<3	<3	<3.0	5.0	4.2	<3.0	<3.0	<3.0
Spec. Cond.	350	45	348.5	354	394	391	376	384	386	400	400	391	219	361	361
Temperature	21	7	16	18.3	18	16	13.5	17	16	17.8	16.6	18.7	17.4	15.1	15.1
Ammonia N	1.4	0.35	0.27	<0.1	0.2	<0.1				<0.10				<0.10	<0.10
Nitrite N	<0.05	<0.05					<0.05							<0.050	<0.050
Nitrate N	0.15	0.08	0.06	0.14	0.12	0.14	<0.05	0.33	0.13	0.138	0.141	0.331	0.143	0.170	0.150
Cyanide (total)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.010	<0.006	<0.006	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
TDS	116	260	259	260	274	224	236	525	230	241	252	231	200	232	239
TSS													88		

B 22

GW-6 GW-6

LOCATION 18937.500, 6179.100

COLLAR ELEVATION - 425.900
DEPTH OF WELL - 28.4ft

DATE	3/27/91	6/28/91	9/19/91	12/19/91	2/28/92	5/14/92	8/25/92	11/23/92	2/24/93	5/10/93	8/17/93	11/15/93	2/14/94	5/9/94
DEPTH TO WATER	2.6	2.4	4.79	6.42	5.33	6.29	4.97	3.96	2.54	2.42	2.95	3.39	2.6	19.08
WATER ELEVATION	423.3	423.5	421.11	419.48	420.57	419.61	420.93	421.94	423.36	423.48	422.95	422.51	423.3	406.82
Silver	<0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.010	<0.010	<0.010
Aluminum	1.2	1.8	1.5	0.6	2.6	1.8	0.5	2.16	0.655	0.911	0.296	1.20	0.824	0.139
Barium	0.03	0.03	0.05	0.04	0.03	0.05	0.04	0.055	0.026	0.035	0.041	0.049	0.032	0.021
Calcium	18.1	21.7	21.6	22.5	18.7	22	22	20.3				17.4		
Cadmium	<0.002	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0011	<0.00100	<0.00100	<0.001	<0.001	0.0050	<0.0050
Chromium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.003	<0.0020	0.002	<0.002	<0.002	<0.010	<0.010
Copper	<0.02	0.02	0.03	<0.01	0.02	<0.01	<0.02	0.007	<0.0040	0.004	<0.004	0.006	<0.020	<0.010
Copper (Dissolved)														
Iron	1.02	1.59	1.06	0.59	2.23	1.2	0.4	2.12	0.558	0.892	0.311	1.51	1.29	0.171
Potassium	<2	2	<2	<2	<2	<2	<2	1.35				1.18		
Magnesium	10.2	11.5	11.8	11.9	10.1	12	12	10.9				9.93		
Manganese	0.22	0.32	1.38	0.96	0.53	1.16	1.21	1.11				1.41		
Sodium	26	29	31	30	22	27	30	28.4				26.0		
Nickel	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.0040	<0.0040	<0.0040	0.005	<0.004	<0.020	<0.020
Zinc	<0.02	0.11	0.08	<0.02	0.02	<0.02	<0.02	0.019	0.008	0.038	0.043	0.030	0.042	0.035
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020
Arsenic	<0.005	<0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050
Lead	0.017	0.015	<0.005	<0.005	0.016	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050
Selenium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050
TOC	5	8	2	1	1	1	2	3	1	2	1	1.9	1.3	1.4
Alkalinity	87.15	86.1	122	118	89	90	107	101				103		
Chloride		49	44	41	43	42	39	39	39	37	34	37.4	38.5	38.2
Fluoride					0.5	0.2	0.2	0.2				0.23		
pH (Lab)	7.0	6.55	6.70	6.27	6.51	6.54	6.68				6.9	6.8	6.6	6.5
pH (Field)					6.61	6.59	6.92	6.83	6.40	6.27	6.27	6.47	6.16	6.52
Sulfate	12	14	16	13	12	11	12	13	14	11	9	11.2	11.4	11.8
Spec. Cond.	290	320	320	316	312.5	349.8	194	339	313	311	296	314	296	285
Temperature	23	22.5		20	14.7	15.6	18	17	12	15	21	19.9	12.3	19.5
Ammonia N	0.19	0.24		<0.1	<0.1	0.1	0.3	0.3				<0.10		
Nitrite N			<0.05	<0.05					<0.05					
Nitrate N	0.06	<0.05	<0.05	0.19	0.10	<0.05	<0.05	0.13	0.08	<0.05	<0.05	0.058	0.122	0.269
Cyanide (total)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.010	<0.006	<0.006	<0.005	<0.0050	<0.0050	<0.0050
TDS	272	220	162	216	234	235	245	210	197	219	201	196	203	182
TSS														

B23

/8/94	12/8/94
3.19	2.81
422.71	423.09
<0.010	<0.010
0.282	0.486
0.039	0.022
	16.6
<0.0050	<0.001
<0.010	<0.002
0.006	<0.004
<0.002	
0.405	0.514
	0.874
	8.99
	0.356
	25.4
<0.020	<0.004
<0.020	0.018
.00020	<0.00020
<0.0050	<0.0050
<0.0050	<0.0050
<0.0050	<0.0050
2.1	1.0
	88.2
35.8	36.4
	0.15
7.0	6.6
6.13	6.60
10.5	11.4
144	269
17.4	16.5
	<0.10
	<0.050
0.055	0.137
0.0050	<0.0050
212	179
20	

B 24

N

N

LOCATION 18757.420, 6358.792

COLLAR ELEVATION ~ 433.935
DEPTH OF WELL ~ 27.07

DATE	1/14/92	1/22/92	2/27/92	5/14/92	8/25/92	11/23/92	2/24/93	5/18/93	8/17/03	11/15/93	2/14/94	5/9/94	8/8/94	12/8/94
DEPTH TO WATER	16.43	16.14	15.07	15.39	15.4	14.09	12.17	16.53	14.3	14.46	12.44	13.28	13.70	12.94
WATER ELEVATION	417.505	417.795	418.865	418.545	418.535	419.845	421.765	417.405	419.635	419.475	421.495	420.655	420.235	420.395
Silver	<0.010	<0.010	<0.010	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.010	<0.010	<0.010	<0.020	<0.010
Aluminum	35.1	48.1	38.8	24.0	25.1	19.9	24.5	33.3	53.1	18.4	17.7	38.2	36.6	38.2
Barium	0.09	0.11	0.11	0.07	0.05	0.045	0.049	0.086	0.120	0.047	0.047	0.096	0.087	0.075
Calcium	36.8	31.4	31.0	30	31	29.6				26.9				34.6
Cadmium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.00100	<0.00100	<0.0050	<0.001	0.0014	<0.0050	<0.0050	<0.0050	0.0018
Chromium	0.04	0.04	0.05	0.02	0.03	0.017	0.024	0.034	0.037	0.016	0.026	0.045	0.047	0.041
Copper	0.03	0.03	0.05	0.02	<0.02	0.015	0.016	0.038	0.043	0.020	0.024	0.053	0.038	0.035
Copper (Dissolved)													0.003	
Iron	45.8	61.4	41.2	27	29.4	20.3	24.2	39.5	56.9	21.7	23.3	47.8	47.8	41.5
Potassium	7	4	5	2	2	2.90				1.57				2.16
Magnesium	42.0	48.1	34.0	34	34	31.4				31.1				41.6
Manganese	2.01	2.74	2.60	1.58	1.27	0.833				1.27				1.89
Sodium	48	44	36.00	45.00	50.00	49.8				44.2				48.4
Nickel	0.02	0.02	0.02	<0.02	<0.02	0.007	0.007	0.085	0.031	0.009	<0.020	<0.020	0.02	0.013
Zinc	0.33	0.44	0.30	0.20	0.17	0.165	0.154	1.44	0.544	0.157	0.168	0.344	0.305	0.241
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Arsenic	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Lead	0.019	0.006	0.010	<0.005	0.006	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	0.0068	0.0114	0.0112
Selenium	<0.005	<0.025	<0.025	<0.020	<0.005	<0.005	<0.005	<0.040	<0.005	<0.0050	<0.0050	<0.020	<0.0050	<0.0050
TOC	2	2	2	1	1	5	2	2	2	2.2	1.6	1.8	2.2	1.6
Alkalinity	201	206	214	196	204	205				196				187
Chloride	50	65	51	55	58	53	59	69	68	62.0	64.3	66.5	68.4	72.0
Fluoride	0.4	0.8		0.3	0.4	0.4				0.87		0.9	0.52	0.21
pH (Lab)	7.28	7.35	7.23	7.07	7.07				6.9	7.0	6.8	6.9	6.7	6.9
pH (Field)			7.31	6.95	7.04	7.01	6.9	7.01	6.75	6.41	6.27	6.52	6.61	6.98
Sulfate X	<12	<75	8	<12	<12	<6	<12	7	<30	<15	<12	<60	<30	<12
Spec. Cond.	500	247	468	528	554	543	548	619	581	533	530	514	539	546
Temperature		13	15	15.6	18	17	12	20	18	19.8	13.6	16.9	20.5	16.5
Ammonia N	0.25	0.14	0.15	0.3	0.2	0.1				<0.10				<0.10
Nitrite N	<0.05	<0.10	<0.05				<0.05							<0.050
Nitrate N	<0.10	<0.10	<0.2	<0.05	<0.05	0.06	<0.05	<0.05	<0.05	<0.25	<0.050	<0.050	0.055	0.374
Cyanide (total)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.010	<0.006	<0.006	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.005
TDS	283	274	1152	299	336	286	366	234	337	302	306	300	314	312
TSS													1270	

Well O

LOCATION 18758.548, 6704.178

COLLAR ELEVATION - 442.445
DEPTH OF WELL - 28.62

DATE	1/22/92	2/28/92	5/14/92	8/25/92	11/23/92	2/24/93	5/18/93	8/17/93	11/15/93	2/14/94	5/9/94	8/8/94	11/30/94
DEPTH TO WATER	26.42	23.16	23.25	23.32	22.34	20.03	20.05	21.16	22.56	20.56	21.16	21.59	21.07
WATER ELEVATION	416.025	419.285	419.195	419.125	420.105	422.415	422.395	421.285	419.885	421.885	421.285	420.855	421.375
Silver	<0.010	<0.010	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.010	<0.010	<0.010	<0.010	<0.010
Aluminum	0.9	1.2	1.4	2.8	12.5	15.4	21.2	17.1	11.5	15.4	10.1	2.54	13.7
Barium	0.03	0.02	0.03	0.03	0.079	0.099	0.325	0.093	0.083	0.148	0.089	<0.020	0.090
Calcium	33.9	29.5	28	31	36.0				33.3				34.9
Cadmium	<0.005	<0.005	<0.005	<0.005	<0.00100	0.0011	<0.00100	<0.001	0.0010	<0.0050	<0.0050	<0.0050	<0.001
Chromium	<0.01	<0.01	<0.01	<0.01	0.007	0.008	0.009	0.009	0.006	0.012	<0.010	<0.010	0.007
Copper	<0.02	<0.02	<0.01	<0.02	0.0040	<0.0040	0.023	0.009	0.008	<0.020	0.013	0.012	0.007
Copper (Dissolved)												0.003	
Iron	1.18	1.48	2.1	3.8	18.7	19.5	10.0	23.6	18.9	24.9	13.8	16.6	20.3
Potassium	4	2	2	<2	2.62				2.17				2.22
Magnesium	15.1	15.4	16	18	24.0				24.1				23.9
Manganese	0.10	0.08	0.06	0.11	0.612				0.664				0.699
Sodium	26	24	26.00	26	26.9				24.7				26.0
Nickel	<0.02	<0.02	<0.02	<0.02	0.006	0.006	0.004	0.012	0.007	<0.020	<0.020	<0.020	0.007
Zinc	0.02	<0.02	0.02	0.04	0.092	0.098	0.094	0.181	0.111		0.356	0.087	0.106
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Arsenic	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Lead	0.013	0.010	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Selenium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.020	<0.005	<0.005	<0.0050	<0.010	<0.0050	<0.0050	<0.020
TOC		2	1	2	3	2	5	2	2.1	2.2	2.4	2.8	1.6
Alkalinity		129	134	140	140				141				130
Chloride	60	60	58	57	55	60	62	60	59.1	61.9	61.7	60.4	63.0
Fluoride	0.2	0.5	0.2	0.2	0.3				0.29				0.19
pH (Lab)	7.27	7.14	6.92	6.94				6.8	6.7	6.4	6.8	6.9	
pH (Field)		6.93	6.83	7.24	7.04	6.56	6.44	6.64	6.26	6.23	6.53	6.39	6.74
Sulfate X	11	3	<3	<3	<6	<3	<6	<3	<6.0	<6.0	<12	<15	<6.0
Spec. Cond.	201	433	440	253	451	443	467	448	446	439	439	257	396
Temperature	13	15.5	16.7	18	16	14	17	17	19.6	15.6	18.4	19.5	16.1
Ammonia N		0.13	<0.1	0.2	0.4				<0.10				0.16
Nitrite N	<0.05					<0.05							<0.050
Nitrate N		0.35	0.37	0.41	0.44	0.31	0.27	0.26	0.200	0.174	0.257	0.350	0.329
Cyanide (total)		<0.005	<0.005	<0.005	<0.010	<0.006	<0.006	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
TDS	222	258	267	294	252	269	303	297	275	268	258	267	283
TSS												875	

Well L2

LOCATION 19275.583, 7092.098

COLLAR ELEVATION - 462.221
DEPTH OF WELL - 81.91

DATE	8/7/92	8/25/92	11/23/92	duplicate 11/23/92	2/24/93	5/18/93	duplicate 5/18/93	8/17/93	11/15/93	2/14/94	duplicat 2/14/94	5/9/94	duplicate 5/9/94	8/8/94
DEPTH TO WATER	38	37.51	36.33		33.62	31.95		33.96	35.43	34.51		33.78		34.68
WATER ELEVATION	424.221	424.711	425.891		428.601	430.271		428.261	426.791	427.711		428.441		427.541
Silver	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Aluminum	209	88.6	36.5	32.0	13.1	9.65	5.74	4.91	1.14	1.02	1.14	2.74	4.36	6.44
Barium	0.30	0.17	0.079	0.069	0.026	0.027	<0.020	0.022	0.006	<0.020	<0.020	<0.020	0.025	0.026
Calcium	67	57	50.0	49.2					43.5					
Cadmium	0.006	<0.005	0.0015	0.0011	<0.00100	<0.0050	<0.0050	<0.001	<0.001	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Chromium	0.07	0.19	0.018	0.018	0.020	0.013	0.015	0.028	0.010	<0.010	<0.010	<0.010	0.012	<0.010
Copper	0.25	0.15	0.066	0.056	0.022	<0.020	0.021	0.017	0.005	<0.020	<0.020	0.014	0.023	0.030
Copper (Dissolved)														0.003
Iron	160	91.7	43.4	39.2	13.1	7.65	6.08	7.19	2.02	1.69	1.78	3.32	7.57	7.9
Potassium	4	<2	1.18	0.963					<0.4					
Magnesium	38	29	22.0	21.4					16.6					
Manganese	12.70	7.35	3.57	3.10					0.106					
Sodium	24	29	22.2	22.3					20.9					
Nickel	0.06	0.05	0.028	0.029	0.011	<0.020	<0.020	0.016	0.011	<0.020	<0.020	<0.020	0.040	<0.020
Zinc	0.23	0.18	0.074	0.061	0.028	0.079	0.123	0.051	0.017	0.105	0.079	0.021	0.151	0.029
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Arsenic	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Lead	0.020	0.028	0.009	0.008	<0.005	0.006	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Selenium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
TOC	2	<1	2	7	1	1	2	2	2.4	1.5	1.2	1.5	1.2	1.2
Alkalinity	146	138	138	139					146					
Chloride	73	77	75	75	80	81	81	79	81.0	81.9	80.2	80.6	80.7	74.2
Fluoride	0.9	0.5	0.2	0.2					0.18					
pH (Lab)	6.96	6.81						6.9	6.9	6.6	6.5	6.7	6.7	6.9
pH (Field)	6.84	6.12	6.79		6.32	6.46		6.67	6.25	6.55		6.59		6.47
Sulfate	<60	<30	<12	<6	<6	<6	<3		3.4	3.5	4.0	5.6	14	<6.0
Spec. Cond.	493	504	510		511	504		496	498	515		470		628
Temperature	17	19	16		13	20		18	18.8	17.2		19.1		19.5
Ammonia N	0.40	0.3	<0.1	0.1					0.20					
Nitrite N					<0.05									
Nitrate N	0.29	0.37	0.42	0.43	0.36	0.38	0.37	0.34	0.363	0.380	0.375	0.359	0.558	0.341
Cyanide (total)	<0.005	<0.005	<0.050	<0.100	<0.006	<0.006	<0.006	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
TDS	657	405	481	460	363	326	377	363	325	314	304	295	292	350
TSS														171

1/30/94	
34.29	MEAN
427.931	"X"
<0.002	0
3.09	49.9375
0.014	0.086625
44.7	55.8
<0.001	0.001075
0.007	0.0465
0.010	0.07275
3.91	46.04
0.474	1.53575
17.2	27.6
0.291	6.68
21.7	24.375
0.012	0.0255
0.038	0.1025
.00020	0
0.0050	0
0.0050	0.009875
0.0050	0
2.1	2.125
135	140.25
80.1	77.625
0.12	0.45
	6.89
6.63	6.533333
4.2	0
457	503
14.5	17
<0.10	0.2
<0.050	0
0.366	0.37
0.0050	0
322	442.5

B 28

MONITOR WELL WATER ELEVATIONS

DATE	GW1	GW2	A	GW3	GW5	GW6
1991	385.82	400.97		375.09	419.71	423.3
	384.98	399.48		373.9	420	423.5
	381.21	398.04	439.83	371.39	418.91	421.11
	383.86	396.69	439.92	370.66	417.38	419.48
1992	385.64	399.67	435.28	375.26	419.23	420.57
	384.24	397.94	433.89	373.74	418.61	419.61
	384.62	398.21	433.45	375.52	418.68	420.93
			436.21		420	421.94
1993	389.09	404.16	440.04	377.87	422.21	423.36
	384.32	397.49	442.96	374.75	421.74	423.48
	383.63	396.68	441.88	373.67	419.28	422.95
	384.51	398.09	439.19	374	418.95	422.51
1994	385.38	397.37	438.04	373.52	421.62	423.3
	383.21	390.87	437.02	373.05	420.23	406.82 *
	383.39	394.89	435.17	375.27	419.81	422.71
HIGH	389.09	404.16	442.96	377.87	422.21	423.5
LOW	381.21	390.87	433.45	370.66	417.38	419.48
DIFF.	7.88	13.29	9.51	7.21	4.83	4.02

*Assumed to be bad reading. Not counted in calc.

These three closest to Main Pit

DATE	I		J	K	B2	D3	F3
1991				410.766			
	417.804		408.139	410.416			
	416.544		407.299	409.556	424.25	432.851	443.653
	412.674		403.629	405.156	423.91	432.791	443.443
1992	413.744		406.539	407.346	423.5	429.331	437.089
	411.884		404.559	406.046	423.5	430.151	428.303
	412.124		403.849	405.626	419.7	429.281	429.073
					420.91	430.591	430.603
1993	419.764		408.719	411.116	425.34	433.671	433.593
	400.224	*	407.799	410.766	428.19	435.891	435.043
	394.664	*	400.379	402.836	424.15	433.511	434.113
	395.744	*	401.483	403.676	422.36	431.341	434.283
1994	392.684	*	407.339	409.576	424.4	432.241	434.813
	411.104	*	407.289	409.956	426.34	433.311	432.903
			402.129	405.106	424.9	432.001	434.143

*Well being continuously pumped

	I	J	K	B2	D3	F3
HIGH	419.764	408.719	411.116	428.19	435.891	443.653
LOW	392.684	400.379	402.836	419.7	429.281	428.303
DIFF.	27.08	8.34	8.28	8.49	6.61	15.35

DATE	H	L2	N	O
1991				
	416.89			
	415.39			
	408.74			
1992	412.74		417.505	416.025
	411.32	424.221	417.795	419.285
	413.12	424.711	418.865	419.195
		425.891	418.545	419.125
			418.535	420.105
			419.845	
1993	420.71	428.601	421.765	422.415
	420.28	430.271	417.405	422.395
	412.92	428.261	419.635	421.285
	420.67	426.791	419.475	419.885
1994	421.56	427.711	421.495	421.885
	419.64	428.441	420.655	421.285
	412.92	427.541	420.235	420.855
HIGH	421.56	430.271	421.765	422.415
LOW	408.74	424.221	417.405	416.025
DIFF.	12.82	6.05	4.36	6.39

APPENDIX C
RUNOFF HYDROGRAPHS FOR EXPOSED AND VEGETATED HEAP

```
*******************************************************
*                                                     *
*    H Y D R O L O G I C A L    S Y S T E M S         *
*                                                     *
*******************************************************
*                                                     *
*           PROGRAM   -   WASHED                      *
*                                                     *
*           WATERSHED MODELLING                       *
*                                                     *
*      PROGRAM TO DETERMINE RUNOFF HYDROGRAPHS        *
*      AND SEDIMENTGRAPHS FOR SMALL CATCHMENTS        *
*                                                     *
*******************************************************
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```
COMPANY DOING ANALYSIS :   SRK
ENGINEER               :   PEK
DATE                   :   24-MAR-95
CLIENT                 :   NEVADA GOLDFIELDS
PROJECT DESCRIPTION    :   BARITE HILL
MAJOR WATERSHED NAME   :   RECLAIMED HEAP

THE INPUT DATA FILE IS                     :BARITE1.IN
THE FLOOD HYDROGRAPH AND SEDIMENTGRAPH IS NOT STORED
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*************************************************************
WATERSHED CONDITIONS AT  RECLAIMED HEAP
*************************************************************

GLOBAL PARAMETERS
-----------------

RAINFALL                                    (mm.)    :    203.20
INITIAL ABSTRACTION                         (mm.)    :       .00
  -- will default to the SCS method
TIME INCREMENT OF HYDROGRAPH FROM START OF RUNOFF    :       .17

RAINFALL DISTRIBUTION SELECTED                  :SCS TYPE 2 CURVE
```

****

SUBWATERSHED CONDITIONS AT SUB-1

****

RAINFALL PARAMETERS

SCS CURVE NUMBER		:	93.90
UNIT HYDROGRAPH SELECTED		:	HAANS

MAP PARAMETERS

AREA	(ha.)	:	1.49
HYDRAULIC LENGTH	(m.)	:	120.39
PERCENT FOREST	(%)	:	.00
PERCENT AGRICULTURE	(%)	:	.00
PERCENT GRASSLAND	(%)	:	.00
OVERLAND FLOW SLOPE	(%)	:	2.90
CHANNEL SLOPE	(%)	:	33.33
CHANNEL LENGTH FROM SUBWATERSHED	(m.)	:	41.15
TYPE OF CHANNEL FROM SUBWATERSHED		:	AN UNLINED CHANNEL
CORRECTION FACTOR FOR IMPERVIOUS AREA		:	1.00
CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS		:	1.00
AREAL REDUCTION FACTOR		:	1.00

SEDIMENT PARAMETERS

THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

==

********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.1	.1	.2	.2	.4	.6	.8
12.0 *	.9	.3	.1	.1	.1	.1	.1	.1	.1	.1
13.0 *	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1
14.0 *	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0
15.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
16.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
17.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
18.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
19.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
20.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
21.0 *	.0	.0	.0	.0	.0	.0				

INITIAL ABSTRACTION	=	3.30	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.00	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	186.95	mm.
VOLUME OF RUNOFF	=	2.78	thousand cu.m.
PEAK RUNOFF RATE	=	.86	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

****

SUBWATERSHED CONDITIONS AT SUB-2

****

RAINFALL PARAMETERS

SCS CURVE NUMBER		:	93.90
UNIT HYDROGRAPH SELECTED		:	HAANS

MAP PARAMETERS

AREA	(ha.)	:	.77
HYDRAULIC LENGTH	(m.)	:	155.44
PERCENT FOREST	(%)	:	.00
PERCENT AGRICULTURE	(%)	:	.00
PERCENT GRASSLAND	(%)	:	.00
OVERLAND FLOW SLOPE	(%)	:	3.50
CHANNEL SLOPE	(%)	:	2.75
CHANNEL LENGTH FROM SUBWATERSHED	(m.)	:	121.91
TYPE OF CHANNEL FROM SUBWATERSHED		:	AN UNLINED CHANNEL
CORRECTION FACTOR FOR IMPERVIOUS AREA		:	1.00
CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS		:	1.00
AREAL REDUCTION FACTOR		:	1.00

SEDIMENT PARAMETERS

THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.0	.1	.1	.1	.2	.3	.4
12.0 *	.4	.1	.0	.0	.0	.0	.0	.0	.0	.0
13.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
14.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
15.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
16.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
17.0 *	.0									

INITIAL ABSTRACTION	=	3.30	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.00	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	186.95	mm.
VOLUME OF RUNOFF	=	1.44	thousand cu.m.
PEAK RUNOFF RATE	=	.44	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

==

****

SUBWATERSHED CONDITIONS AT SUB-3

****

RAINFALL PARAMETERS

SCS CURVE NUMBER		:	94.60
UNIT HYDROGRAPH SELECTED		:	HAANS

MAP PARAMETERS

AREA	(ha.)	:	.34
HYDRAULIC LENGTH	(m.)	:	170.68
PERCENT FOREST	(%)	:	.00
PERCENT AGRICULTURE	(%)	:	.00
PERCENT GRASSLAND	(%)	:	.00
OVERLAND FLOW SLOPE	(%)	:	8.36
CHANNEL SLOPE	(%)	:	2.75
CHANNEL LENGTH FROM SUBWATERSHED	(m.)	:	121.91
TYPE OF CHANNEL FROM SUBWATERSHED		:	AN UNLINED CHANNEL
CORRECTION FACTOR FOR IMPERVIOUS AREA		:	1.00
CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS		:	1.00
AREAL REDUCTION FACTOR		:	1.00

SEDIMENT PARAMETERS

THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

==

********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.0	.0	.0	.0	.1	.1	.2
12.0 *	.2	.1	.0	.0	.0	.0	.0	.0	.0	.0
13.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

INITIAL ABSTRACTION	=	2.90	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.00	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	189.10	mm.
VOLUME OF RUNOFF	=	.64	thousand cu.m.
PEAK RUNOFF RATE	=	.20	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

****

SUBWATERSHED CONDITIONS AT SUB-4

****

RAINFALL PARAMETERS

SCS CURVE NUMBER	:	94.60
UNIT HYDROGRAPH SELECTED	:	HAANS

MAP PARAMETERS

AREA	(ha.)	:	.37
HYDRAULIC LENGTH	(m.)	:	175.25
PERCENT FOREST	(%)	:	.00
PERCENT AGRICULTURE	(%)	:	.00
PERCENT GRASSLAND	(%)	:	.00
OVERLAND FLOW SLOPE	(%)	:	5.45
CHANNEL SLOPE	(%)	:	2.60
CHANNEL LENGTH FROM SUBWATERSHED	(m.)	:	304.79
TYPE OF CHANNEL FROM SUBWATERSHED		:	AN UNLINED CHANNEL
CORRECTION FACTOR FOR IMPERVIOUS AREA		:	1.00
CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS		:	1.00
AREAL REDUCTION FACTOR		:	1.00

SEDIMENT PARAMETERS

THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.0	.0	.0	.0	.1	.1	.2
12.0 *	.2	.1	.0	.0	.0	.0	.0	.0	.0	.0
13.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

INITIAL ABSTRACTION	=	2.90	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.05	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	189.10	mm.
VOLUME OF RUNOFF	=	.70	thousand cu.m.
PEAK RUNOFF RATE	=	.21	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

****

SUBWATERSHED CONDITIONS AT SUB-5

****

RAINFALL PARAMETERS

SCS CURVE NUMBER		:	94.60
UNIT HYDROGRAPH SELECTED		:	HAANS

MAP PARAMETERS

AREA	(ha.)	:	.49
HYDRAULIC LENGTH	(m.)	:	219.45
PERCENT FOREST	(%)	:	.00
PERCENT AGRICULTURE	(%)	:	.00
PERCENT GRASSLAND	(%)	:	.00
OVERLAND FLOW SLOPE	(%)	:	8.00
CHANNEL SLOPE	(%)	:	1.43
CHANNEL LENGTH FROM SUBWATERSHED	(m.)	:	106.67
TYPE OF CHANNEL FROM SUBWATERSHED		:	AN UNLINED CHANNEL
CORRECTION FACTOR FOR IMPERVIOUS AREA		:	1.00
CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS		:	1.00
AREAL REDUCTION FACTOR		:	1.00

SEDIMENT PARAMETERS

THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.0	.0	.1	.1	.1	.2	.3
12.0 *	.3	.1	.0	.0	.0	.0	.0	.0	.0	.0
13.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
14.0 *	.0									

INITIAL ABSTRACTION	=	2.90	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.00	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	189.10	mm.
VOLUME OF RUNOFF	=	.93	thousand cu.m.
PEAK RUNOFF RATE	=	.28	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

==

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

==

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SUBWATERSHED CONDITIONS AT SUB-6

****

RAINFALL PARAMETERS

SCS CURVE NUMBER		:	94.60
UNIT HYDROGRAPH SELECTED		:	HAANS

MAP PARAMETERS

AREA	(ha.)	:	.41
HYDRAULIC LENGTH	(m.)	:	148.74
PERCENT FOREST	(%)	:	.00
PERCENT AGRICULTURE	(%)	:	.00
PERCENT GRASSLAND	(%)	:	.00
OVERLAND FLOW SLOPE	(%)	:	1046.00
CHANNEL SLOPE	(%)	:	.01
CHANNEL LENGTH FROM SUBWATERSHED	(m.)	:	.00
TYPE OF CHANNEL FROM SUBWATERSHED		:	AN UNLINED CHANNEL
CORRECTION FACTOR FOR IMPERVIOUS AREA		:	1.00
CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS		:	1.00
AREAL REDUCTION FACTOR		:	1.00

SEDIMENT PARAMETERS

THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.0	.0	.0	.0	.1	.2	.2
12.0 *	.2	.1	.0	.0	.0	.0	.0	.0	.0	.0
13.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

INITIAL ABSTRACTION	=	2.90	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.00	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	189.10	mm.
VOLUME OF RUNOFF	=	.77	thousand cu.m.
PEAK RUNOFF RATE	=	.24	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

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SUBWATERSHED CONDITIONS AT SUB-7

****

RAINFALL PARAMETERS

SCS CURVE NUMBER		:	94.60
UNIT HYDROGRAPH SELECTED		:	HAANS

MAP PARAMETERS

AREA	(ha.)	:	.42
HYDRAULIC LENGTH	(m.)	:	167.63
PERCENT FOREST	(%)	:	.00
PERCENT AGRICULTURE	(%)	:	.00
PERCENT GRASSLAND	(%)	:	.00
OVERLAND FLOW SLOPE	(%)	:	11.09
CHANNEL SLOPE	(%)	:	.01
CHANNEL LENGTH FROM SUBWATERSHED	(m.)	:	.00
TYPE OF CHANNEL FROM SUBWATERSHED		:	AN UNLINED CHANNEL
CORRECTION FACTOR FOR IMPERVIOUS AREA		:	1.00
CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS		:	1.00
AREAL REDUCTION FACTOR		:	1.00

SEDIMENT PARAMETERS

THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

==

********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.0	.0	.0	.0	.1	.2	.2
12.0 *	.2	.1	.0	.0	.0	.0	.0	.0	.0	.0
13.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

INITIAL ABSTRACTION	=	2.90	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.00	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	189.10	mm.
VOLUME OF RUNOFF	=	.79	thousand cu.m.
PEAK RUNOFF RATE	=	.24	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

STORM HYDROGRAPH FOR WATERSHED RECLAIMED HEAP

TOTAL AREA OF THE WATERSHED	=	4.29	ha.
THE DEPTH OF WATER ON WATERSHED	=	187.97	mm.
VOLUME OF RUNOFF	=	8.06	thousand cu.m.
PEAK RUNOFF RATE	=	2.47	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.
TIME INCREMENT OF NEW HYDROGRAPH	=	.17	hours.
NUMBER OF RUNOFF VALUES	=	148	

******* STORM HYDROGRAPH GENERATED FROM START OF RUNOFF *******

.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.1	.1	.1
.1	.1	.1	.1	.1	.1	.1	.1	.1	.1
.1	.1	.1	.1	.1	.1	.1	.1	.1	.1
.1	.1	.1	.3	.3	.5	1.5	2.2	2.5	.2
.2	.2	.2	.2	.2	.2	.2	.2	.2	.2
.2	.1	.1	.1	.1	.1	.1	.1	.1	.1
.1	.1	.1	.1	.1	.1	.1	.1	.1	.1
.1	.1	.1	.1	.1	.1	.1	.1	.1	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0		

```
******************************************************
*                                                    *
*    H Y D R O L O G I C A L   S Y S T E M S         *
*                                                    *
******************************************************
*                                                    *
*          PROGRAM   -   WASHED                      *
*                                                    *
*          WATERSHED MODELLING                       *
*                                                    *
*     PROGRAM TO DETERMINE RUNOFF HYDROGRAPHS        *
*     AND SEDIMENTGRAPHS FOR SMALL CATCHMENTS        *
*                                                    *
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COMPANY DOING ANALYSIS :   SRK
ENGINEER               :   PEK
DATE                   :   28-MAR-95
CLIENT                 :   NEVADA GOLDFIELDS
PROJECT DESCRIPTION    :   BARITE HILL
MAJOR WATERSHED NAME   :   RECLAIMED HEAP

THE INPUT DATA FILE IS                     :BARITE2.IN
THE FLOOD HYDROGRAPH AND SEDIMENTGRAPH IS NOT STORED
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***************************************************************
WATERSHED CONDITIONS AT  RECLAIMED HEAP
***************************************************************

GLOBAL PARAMETERS
-----------------

RAINFALL                                     (mm.)   :    203.20
INITIAL ABSTRACTION                          (mm.)   :       .00
  -- will default to the SCS method
TIME INCREMENT OF HYDROGRAPH FROM START OF RUNOFF    :       .10

RAINFALL DISTRIBUTION SELECTED                  :SCS TYPE 2 CURVE
```

Runoff Hydrographs
100-yr 24-hr Storm (8")
on exposed topsoil

$CN_{flat} = 93.9$

$CN_{slope} = 94.6$

****

SUBWATERSHED CONDITIONS AT SUB-8

****

RAINFALL PARAMETERS

SCS CURVE NUMBER	:	94.60
UNIT HYDROGRAPH SELECTED	:	HAANS

MAP PARAMETERS

AREA	(ha.)	:	.22
HYDRAULIC LENGTH	(m.)	:	102.10
PERCENT FOREST	(%)	:	.00
PERCENT AGRICULTURE	(%)	:	.00
PERCENT GRASSLAND	(%)	:	.00
OVERLAND FLOW SLOPE	(%)	:	10.91
CHANNEL SLOPE	(%)	:	.01
CHANNEL LENGTH FROM SUBWATERSHED	(m.)	:	.00
TYPE OF CHANNEL FROM SUBWATERSHED		:	AN UNLINED CHANNEL
CORRECTION FACTOR FOR IMPERVIOUS AREA		:	1.00
CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS		:	1.00
AREAL REDUCTION FACTOR		:	1.00

SEDIMENT PARAMETERS

THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.0	.0	.0	.0	.1	.1	.1
12.0 *	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0

INITIAL ABSTRACTION	=	2.90	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.00	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	189.10	mm.
VOLUME OF RUNOFF	=	.42	thousand cu.m.
PEAK RUNOFF RATE	=	.13	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

****

SUBWATERSHED CONDITIONS AT SUB-9

****

RAINFALL PARAMETERS

SCS CURVE NUMBER		:	94.60
UNIT HYDROGRAPH SELECTED		:	HAANS

MAP PARAMETERS

AREA	(ha.)	:	.18
HYDRAULIC LENGTH	(m.)	:	114.29
PERCENT FOREST	(%)	:	.00
PERCENT AGRICULTURE	(%)	:	.00
PERCENT GRASSLAND	(%)	:	.00
OVERLAND FLOW SLOPE	(%)	:	11.47
CHANNEL SLOPE	(%)	:	4.44
CHANNEL LENGTH FROM SUBWATERSHED	(m.)	:	79.24
TYPE OF CHANNEL FROM SUBWATERSHED		:	AN UNLINED CHANNEL
CORRECTION FACTOR FOR IMPERVIOUS AREA		:	1.00
CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS		:	1.00
AREAL REDUCTION FACTOR		:	1.00

SEDIMENT PARAMETERS

THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.0	.0	.0	.0	.1	.1	.1
12.0 *	.1	.0								

INITIAL ABSTRACTION	=	2.90	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.00	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	189.10	mm.
VOLUME OF RUNOFF	=	.34	thousand cu.m.
PEAK RUNOFF RATE	=	.10	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

==

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

==

****

SUBWATERSHED CONDITIONS AT SUB-9A

****

RAINFALL PARAMETERS

SCS CURVE NUMBER		:	94.60
UNIT HYDROGRAPH SELECTED		:	HAANS

MAP PARAMETERS

AREA	(ha.)	:	.12
HYDRAULIC LENGTH	(m.)	:	80.77
PERCENT FOREST	(%)	:	.00
PERCENT AGRICULTURE	(%)	:	.00
PERCENT GRASSLAND	(%)	:	.00
OVERLAND FLOW SLOPE	(%)	:	10.19
CHANNEL SLOPE	(%)	:	5.28
CHANNEL LENGTH FROM SUBWATERSHED	(m.)	:	170.68
TYPE OF CHANNEL FROM SUBWATERSHED		:	AN UNLINED CHANNEL
CORRECTION FACTOR FOR IMPERVIOUS AREA		:	1.00
CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS		:	1.00
AREAL REDUCTION FACTOR		:	1.00

SEDIMENT PARAMETERS

THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1
12.0 *	.1									

INITIAL ABSTRACTION	=	2.90	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.00	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	189.10	mm.
VOLUME OF RUNOFF	=	.23	thousand cu.m.
PEAK RUNOFF RATE	=	.07	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

****

SUBWATERSHED CONDITIONS AT SUB-10

****

RAINFALL PARAMETERS

SCS CURVE NUMBER	:	94.60
UNIT HYDROGRAPH SELECTED	:	HAANS

MAP PARAMETERS

AREA	(ha.)	:	.23
HYDRAULIC LENGTH	(m.)	:	141.73
PERCENT FOREST	(%)	:	.00
PERCENT AGRICULTURE	(%)	:	.00
PERCENT GRASSLAND	(%)	:	.00
OVERLAND FLOW SLOPE	(%)	:	7.26
CHANNEL SLOPE	(%)	:	4.21
CHANNEL LENGTH FROM SUBWATERSHED	(m.)	:	228.59
TYPE OF CHANNEL FROM SUBWATERSHED		:	AN UNLINED CHANNEL
CORRECTION FACTOR FOR IMPERVIOUS AREA		:	1.00
CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS		:	1.00
AREAL REDUCTION FACTOR		:	1.00

SEDIMENT PARAMETERS

THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.0	.0	.0	.0	.1	.1	.1
12.0 *	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0
13.0 *	.0	.0								

INITIAL ABSTRACTION	=	2.90	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.00	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	189.10	mm.
VOLUME OF RUNOFF	=	.43	thousand cu.m.
PEAK RUNOFF RATE	=	.13	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

****
SUBWATERSHED CONDITIONS AT SUB-11
****

RAINFALL PARAMETERS

SCS CURVE NUMBER		:	94.60
UNIT HYDROGRAPH SELECTED		:	HAANS

MAP PARAMETERS

AREA	(ha.)	:	.54
HYDRAULIC LENGTH	(m.)	:	190.49
PERCENT FOREST	(%)	:	.00
PERCENT AGRICULTURE	(%)	:	.00
PERCENT GRASSLAND	(%)	:	.00
OVERLAND FLOW SLOPE	(%)	:	6.80
CHANNEL SLOPE	(%)	:	.01
CHANNEL LENGTH FROM SUBWATERSHED	(m.)	:	.00
TYPE OF CHANNEL FROM SUBWATERSHED		:	AN UNLINED CHANNEL
CORRECTION FACTOR FOR IMPERVIOUS AREA		:	1.00
CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS		:	1.00
AREAL REDUCTION FACTOR		:	1.00

SEDIMENT PARAMETERS

THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.0	.0	.1	.1	.2	.2	.3
12.0 *	.3	.1	.0	.0	.0	.0	.0	.0	.0	.0
13.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
14.0 *	.0									

INITIAL ABSTRACTION	=	2.90	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.00	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	189.10	mm.
VOLUME OF RUNOFF	=	1.02	thousand cu.m.
PEAK RUNOFF RATE	=	.31	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

****

SUBWATERSHED CONDITIONS AT SUB-12

****

RAINFALL PARAMETERS

SCS CURVE NUMBER	:	94.60
UNIT HYDROGRAPH SELECTED	:	HAANS

MAP PARAMETERS

AREA	(ha.)	:	.65
HYDRAULIC LENGTH	(m.)	:	281.93
PERCENT FOREST	(%)	:	.00
PERCENT AGRICULTURE	(%)	:	.00
PERCENT GRASSLAND	(%)	:	.00
OVERLAND FLOW SLOPE	(%)	:	6.81
CHANNEL SLOPE	(%)	:	1.75
CHANNEL LENGTH FROM SUBWATERSHED	(m.)	:	160.01
TYPE OF CHANNEL FROM SUBWATERSHED		:	AN UNLINED CHANNEL
CORRECTION FACTOR FOR IMPERVIOUS AREA		:	1.00
CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS		:	1.00
AREAL REDUCTION FACTOR		:	1.00

SEDIMENT PARAMETERS

THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.0	.0	.1	.1	.2	.2	.3
12.0 *	.4	.1	.0	.0	.0	.0	.0	.0	.0	.0
13.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
14.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
15.0 *	.0	.0	.0	.0						

INITIAL ABSTRACTION	=	2.90	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.00	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	189.10	mm.
VOLUME OF RUNOFF	=	1.23	thousand cu.m.
PEAK RUNOFF RATE	=	.37	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

****

SUBWATERSHED CONDITIONS AT SUB-13

****

RAINFALL PARAMETERS

SCS CURVE NUMBER	:	94.60
UNIT HYDROGRAPH SELECTED	:	HAANS

MAP PARAMETERS

AREA	(ha.)	:	.26
HYDRAULIC LENGTH	(m.)	:	124.96
PERCENT FOREST	(%)	:	.00
PERCENT AGRICULTURE	(%)	:	.00
PERCENT GRASSLAND	(%)	:	.00
OVERLAND FLOW SLOPE	(%)	:	8.89
CHANNEL SLOPE	(%)	:	2.88
CHANNEL LENGTH FROM SUBWATERSHED	(m.)	:	411.46
TYPE OF CHANNEL FROM SUBWATERSHED		:	AN UNLINED CHANNEL
CORRECTION FACTOR FOR IMPERVIOUS AREA		:	1.00
CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS		:	1.00
AREAL REDUCTION FACTOR		:	1.00

SEDIMENT PARAMETERS

THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.0	.0	.0	.0	.1	.1	.1
12.0 *	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0
13.0 *	.0	.0	.0	.0	.0	.0				

INITIAL ABSTRACTION	=	2.90	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.05	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	189.10	mm.
VOLUME OF RUNOFF	=	.49	thousand cu.m.
PEAK RUNOFF RATE	=	.15	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

===

****
SUBWATERSHED CONDITIONS AT SUB-14
****

RAINFALL PARAMETERS

SCS CURVE NUMBER	:	94.60
UNIT HYDROGRAPH SELECTED	:	HAANS

MAP PARAMETERS

AREA	(ha.)	:	.38
HYDRAULIC LENGTH	(m.)	:	164.58
PERCENT FOREST	(%)	:	.00
PERCENT AGRICULTURE	(%)	:	.00
PERCENT GRASSLAND	(%)	:	.00
OVERLAND FLOW SLOPE	(%)	:	6.38
CHANNEL SLOPE	(%)	:	2.53
CHANNEL LENGTH FROM SUBWATERSHED	(m.)	:	505.94
TYPE OF CHANNEL FROM SUBWATERSHED		:	AN UNLINED CHANNEL
CORRECTION FACTOR FOR IMPERVIOUS AREA		:	1.00
CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS		:	1.00
AREAL REDUCTION FACTOR		:	1.00

SEDIMENT PARAMETERS

THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

===

********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.0	.0	.0	.0	.1	.1	.2
12.0 *	.2	.1	.0	.0	.0	.0	.0	.0	.0	.0
13.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

INITIAL ABSTRACTION	=	2.90	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.05	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	189.10	mm.
VOLUME OF RUNOFF	=	.72	thousand cu.m.
PEAK RUNOFF RATE	=	.22	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

STORM HYDROGRAPH FOR WATERSHED RECLAIMED HEAP

TOTAL AREA OF THE WATERSHED	=	2.58	ha.
THE DEPTH OF WATER ON WATERSHED	=	189.10	mm.
VOLUME OF RUNOFF	=	4.88	thousand cu.m.
PEAK RUNOFF RATE	=	1.49	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.
TIME INCREMENT OF NEW HYDROGRAPH	=	.10	hours.
NUMBER OF RUNOFF VALUES	=	219	

******* STORM HYDROGRAPH GENERATED FROM START OF RUNOFF *******

.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.1	.1	.1	.1	.1	.1	.1	.1
.1	.1	.1	.1	.1	.1	.2	.2	.3	.3
.9	1.0	1.4	1.5	.3	.1	.1	.1	.1	.1
.1	.1	.1	.1	.1	.1	.1	.1	.1	.1
.1	.1	.1	.1	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

```
==========================================================================

      *******************************************************
      *                                                     *
      *     H Y D R O L O G I C A L   S Y S T E M S         *
      *                                                     *
      *******************************************************
      *                                                     *
      *            PROGRAM    -   WASHED                    *
      *                                                     *
      *            WATERSHED MODELLING                      *
      *                                                     *
      *       PROGRAM TO DETERMINE RUNOFF HYDROGRAPHS       *
      *       AND SEDIMENTGRAPHS FOR SMALL CATCHMENTS       *
      *                                                     *
      *******************************************************


      COMPANY DOING ANALYSIS :   SRK
      ENGINEER               :   PEK
      DATE                   :   24-MAR-95
      CLIENT                 :
      PROJECT DESCRIPTION    :   BARITE HILL
      MAJOR WATERSHED NAME   :   RECLAIMED HEAP

      THE INPUT DATA FILE IS                      :BARITE1A.I
      THE FLOOD HYDROGRAPH AND SEDIMENTGRAPH IS NOT STORED

==========================================================================

      **************************************************************
      WATERSHED CONDITIONS AT  RECLAIMED HEAP
      **************************************************************

      GLOBAL PARAMETERS
      -----------------

      RAINFALL                                     (mm.)    :    203.20
      INITIAL ABSTRACTION                          (mm.)    :       .00
        -- will default to the SCS method
      TIME INCREMENT OF HYDROGRAPH FROM START OF RUNOFF     :       .17

      RAINFALL DISTRIBUTION SELECTED                  :SCS TYPE 2 CURVE

==========================================================================
```

C36

****
SUBWATERSHED CONDITIONS AT SUB-1
****

RAINFALL PARAMETERS

SCS CURVE NUMBER		:	80.60
UNIT HYDROGRAPH SELECTED		:	HAANS

MAP PARAMETERS

AREA	(ha.)	:	1.49
HYDRAULIC LENGTH	(m.)	:	120.39
PERCENT FOREST	(%)	:	.00
PERCENT AGRICULTURE	(%)	:	.00
PERCENT GRASSLAND	(%)	:	.00
OVERLAND FLOW SLOPE	(%)	:	2.90
CHANNEL SLOPE	(%)	:	33.33
CHANNEL LENGTH FROM SUBWATERSHED	(m.)	:	41.15
TYPE OF CHANNEL FROM SUBWATERSHED		:	AN UNLINED CHANNEL
CORRECTION FACTOR FOR IMPERVIOUS AREA		:	1.00
CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS		:	1.00
AREAL REDUCTION FACTOR		:	1.00

SEDIMENT PARAMETERS

THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

==

********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.1	.1	.1	.1	.3	.4	.6
12.0 *	.7	.3	.1	.1	.1	.1	.1	.1	.1	.1
13.0 *	.1	.1	.1	.1	.1	.1	.1	.1	.1	.0
14.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
15.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
16.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
17.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
18.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
19.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
20.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
21.0 *	.0	.0								

INITIAL ABSTRACTION	=	12.23	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.00	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	146.46	mm.
VOLUME OF RUNOFF	=	2.18	thousand cu.m.
PEAK RUNOFF RATE	=	.76	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

==

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

==

==

****
SUBWATERSHED CONDITIONS AT SUB-2
****

RAINFALL PARAMETERS

SCS CURVE NUMBER	:	80.60
UNIT HYDROGRAPH SELECTED	:	HAANS

MAP PARAMETERS

AREA	(ha.)	:	.77
HYDRAULIC LENGTH	(m.)	:	155.44
PERCENT FOREST	(%)	:	.00
PERCENT AGRICULTURE	(%)	:	.00
PERCENT GRASSLAND	(%)	:	.00
OVERLAND FLOW SLOPE	(%)	:	3.50
CHANNEL SLOPE	(%)	:	2.75
CHANNEL LENGTH FROM SUBWATERSHED	(m.)	:	121.91
TYPE OF CHANNEL FROM SUBWATERSHED		:	AN UNLINED CHANNEL
CORRECTION FACTOR FOR IMPERVIOUS AREA		:	1.00
CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS		:	1.00
AREAL REDUCTION FACTOR		:	1.00

SEDIMENT PARAMETERS

THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

==

********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.0	.0	.1	.1	.2	.2	.3
12.0 *	.4	.1	.0	.0	.0	.0	.0	.0	.0	.0
13.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
14.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
15.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
16.0 *	.0	.0	.0	.0						

INITIAL ABSTRACTION	=	12.23	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.00	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	146.46	mm.
VOLUME OF RUNOFF	=	1.13	thousand cu.m.
PEAK RUNOFF RATE	=	.39	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

==

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

==

==

****
SUBWATERSHED CONDITIONS AT SUB-3
****

RAINFALL PARAMETERS

SCS CURVE NUMBER		:	82.80
UNIT HYDROGRAPH SELECTED		:	HAANS

MAP PARAMETERS

AREA	(ha.)	:	.34
HYDRAULIC LENGTH	(m.)	:	170.68
PERCENT FOREST	(%)	:	.00
PERCENT AGRICULTURE	(%)	:	.00
PERCENT GRASSLAND	(%)	:	.00
OVERLAND FLOW SLOPE	(%)	:	8.36
CHANNEL SLOPE	(%)	:	2.75
CHANNEL LENGTH FROM SUBWATERSHED	(m.)	:	121.91
TYPE OF CHANNEL FROM SUBWATERSHED		:	AN UNLINED CHANNEL
CORRECTION FACTOR FOR IMPERVIOUS AREA		:	1.00
CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS		:	1.00
AREAL REDUCTION FACTOR		:	1.00

SEDIMENT PARAMETERS

THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

==

*********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.0	.0	.0	.0	.1	.1	.2
12.0 *	.2	.1	.0	.0	.0	.0	.0	.0	.0	.0
13.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

INITIAL ABSTRACTION	=	10.55	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.00	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	153.10	mm.
VOLUME OF RUNOFF	=	.52	thousand cu.m.
PEAK RUNOFF RATE	=	.18	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

==

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

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=========================================================================

     *****************************************************************
     SUBWATERSHED CONDITIONS AT SUB-4
     *****************************************************************

     RAINFALL PARAMETERS
     -------------------

     SCS CURVE NUMBER                                 :  82.80
     UNIT HYDROGRAPH SELECTED                         :  HAANS

     MAP PARAMETERS
     --------------

     AREA                                  (ha.)      :         .37
     HYDRAULIC LENGTH                       (m.)      :      175.25
     PERCENT FOREST                          (%)      :         .00
     PERCENT AGRICULTURE                     (%)      :         .00
     PERCENT GRASSLAND                       (%)      :         .00
     OVERLAND FLOW SLOPE                     (%)      :        5.45
     CHANNEL SLOPE                           (%)      :        2.60
     CHANNEL LENGTH FROM SUBWATERSHED       (m.)      :      304.79
     TYPE OF CHANNEL FROM SUBWATERSHED                :AN UNLINED CHANNEL
     CORRECTION FACTOR FOR IMPERVIOUS AREA            :        1.00
     CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS       :        1.00
     AREAL REDUCTION FACTOR                           :        1.00



     SEDIMENT PARAMETERS
     -------------------

     THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

=========================================================================
```

********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.0	.0	.0	.0	.1	.1	.2
12.0 *	.2	.1	.0	.0	.0	.0	.0	.0	.0	.0
13.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

INITIAL ABSTRACTION	=	10.55	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.05	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	153.10	mm.
VOLUME OF RUNOFF	=	.57	thousand cu.m.
PEAK RUNOFF RATE	=	.19	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

==

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

==

==

****
SUBWATERSHED CONDITIONS AT SUB-5
****

RAINFALL PARAMETERS

SCS CURVE NUMBER	:	82.80
UNIT HYDROGRAPH SELECTED	:	HAANS

MAP PARAMETERS

AREA	(ha.)	:	.49
HYDRAULIC LENGTH	(m.)	:	219.45
PERCENT FOREST	(%)	:	.00
PERCENT AGRICULTURE	(%)	:	.00
PERCENT GRASSLAND	(%)	:	.00
OVERLAND FLOW SLOPE	(%)	:	8.00
CHANNEL SLOPE	(%)	:	1.43
CHANNEL LENGTH FROM SUBWATERSHED	(m.)	:	106.67
TYPE OF CHANNEL FROM SUBWATERSHED		:	AN UNLINED CHANNEL
CORRECTION FACTOR FOR IMPERVIOUS AREA		:	1.00
CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS		:	1.00
AREAL REDUCTION FACTOR		:	1.00

SEDIMENT PARAMETERS

THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

==

********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.0	.0	.0	.0	.1	.2	.2
12.0 *	.3	.1	.0	.0	.0	.0	.0	.0	.0	.0
13.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
14.0 *	.0									

INITIAL ABSTRACTION	=	10.55	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.00	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	153.10	mm.
VOLUME OF RUNOFF	=	.75	thousand cu.m.
PEAK RUNOFF RATE	=	.26	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

===

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

===

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=====================================================================

          ********************************************************************
          SUBWATERSHED CONDITIONS AT SUB-6
          ********************************************************************

          RAINFALL PARAMETERS
          -------------------

          SCS CURVE NUMBER                                  :  82.80
          UNIT HYDROGRAPH SELECTED                          :  HAANS

          MAP PARAMETERS
          --------------

          AREA                                 (ha.)       :         .41
          HYDRAULIC LENGTH                     (m.)        :      148.74
          PERCENT FOREST                       (%)         :         .00
          PERCENT AGRICULTURE                  (%)         :         .00
          PERCENT GRASSLAND                    (%)         :         .00
          OVERLAND FLOW SLOPE                  (%)         :     1046.00
          CHANNEL SLOPE                        (%)         :         .01
          CHANNEL LENGTH FROM SUBWATERSHED     (m.)        :         .00
          TYPE OF CHANNEL FROM SUBWATERSHED                :AN UNLINED CHANNEL
          CORRECTION FACTOR FOR IMPERVIOUS AREA            :        1.00
          CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS       :        1.00
          AREAL REDUCTION FACTOR                           :        1.00


          SEDIMENT PARAMETERS
          -------------------

          THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

=====================================================================
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********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.0	.0	.0	.0	.1	.1	.2
12.0 *	.2	.1	.0	.0	.0	.0	.0	.0	.0	.0
13.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

INITIAL ABSTRACTION	=	10.55	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.00	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	153.10	mm.
VOLUME OF RUNOFF	=	.63	thousand cu.m.
PEAK RUNOFF RATE	=	.22	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

==

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

==

==

****
SUBWATERSHED CONDITIONS AT SUB-7
****

RAINFALL PARAMETERS

SCS CURVE NUMBER		:	82.80
UNIT HYDROGRAPH SELECTED		:	HAANS

MAP PARAMETERS

AREA	(ha.)	:	.42
HYDRAULIC LENGTH	(m.)	:	167.63
PERCENT FOREST	(%)	:	.00
PERCENT AGRICULTURE	(%)	:	.00
PERCENT GRASSLAND	(%)	:	.00
OVERLAND FLOW SLOPE	(%)	:	11.09
CHANNEL SLOPE	(%)	:	.01
CHANNEL LENGTH FROM SUBWATERSHED	(m.)	:	.00
TYPE OF CHANNEL FROM SUBWATERSHED		:	AN UNLINED CHANNEL
CORRECTION FACTOR FOR IMPERVIOUS AREA		:	1.00
CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS		:	1.00
AREAL REDUCTION FACTOR		:	1.00

SEDIMENT PARAMETERS

THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

==

********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.0	.0	.0	.0	.1	.1	.2
12.0 *	.2	.1	.0	.0	.0	.0	.0	.0	.0	.0
13.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

INITIAL ABSTRACTION	=	10.55	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.00	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	153.10	mm.
VOLUME OF RUNOFF	=	.64	thousand cu.m.
PEAK RUNOFF RATE	=	.22	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

==

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

==

STORM HYDROGRAPH FOR WATERSHED RECLAIMED HEAP

TOTAL AREA OF THE WATERSHED	=	4.29	ha.
THE DEPTH OF WATER ON WATERSHED	=	149.60	mm.
VOLUME OF RUNOFF	=	6.41	thousand cu.m.
PEAK RUNOFF RATE	=	2.22	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.
TIME INCREMENT OF NEW HYDROGRAPH	=	.17	hours.
NUMBER OF RUNOFF VALUES	=	128	

******* STORM HYDROGRAPH GENERATED FROM START OF RUNOFF *******

.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.1	.1	.1	.1	.1
.1	.1	.1	.2	.2	.4	1.2	1.9	2.2	.2
.2	.2	.2	.2	.2	.2	.2	.2	.2	.2
.1	.1	.1	.1	.1	.1	.1	.1	.1	.1
.1	.1	.1	.1	.1	.1	.1	.1	.1	.1
.1	.1	.1	.1	.1	.1	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0		

C51

```
=======================================================================

      ******************************************************
      *                                                    *
      *     H Y D R O L O G I C A L   S Y S T E M S        *
      *                                                    *
      ******************************************************
      *                                                    *
      *           PROGRAM  -  WASHED                       *
      *                                                    *
      *           WATERSHED MODELLING                      *
      *                                                    *
      *     PROGRAM TO DETERMINE RUNOFF HYDROGRAPHS        *
      *     AND SEDIMENTGRAPHS FOR SMALL CATCHMENTS        *
      *                                                    *
      ******************************************************


      COMPANY DOING ANALYSIS :  SRK
      ENGINEER               :  PEK
      DATE                   :  28-MAR-95
      CLIENT                 :  NEVADA GOLDFIELDS
      PROJECT DESCRIPTION    :  BARITE HILL
      MAJOR WATERSHED NAME   :  RECLAIMED HEAP


      THE INPUT DATA FILE IS                :BARITE2A.I
      THE FLOOD HYDROGRAPH AND SEDIMENTGRAPH IS NOT STORED

=======================================================================

      ************************************************************
      WATERSHED CONDITIONS AT  RECLAIMED HEAP
      ************************************************************

      GLOBAL PARAMETERS
      -----------------

      RAINFALL                                   (mm.)    :    203.20
      INITIAL ABSTRACTION                        (mm.)    :       .00
        -- will default to the SCS method
      TIME INCREMENT OF HYDROGRAPH FROM START OF RUNOFF   :       .10

      RAINFALL DISTRIBUTION SELECTED               :SCS TYPE 2 CURVE

=======================================================================
```

Runoff Hydrographs
100-yr - 24-hr Storm (8")
on vegetated heap surface
(good grass cover)

CN_{flat} = 80.6
CN_{slope} = 82.8

C52

```
*****************************************************************
SUBWATERSHED CONDITIONS AT SUB-8
*****************************************************************

RAINFALL PARAMETERS
-------------------

SCS CURVE NUMBER                                  :  82.80
UNIT HYDROGRAPH SELECTED                          :  HAANS

MAP PARAMETERS
--------------

AREA                                  (ha.)       :        .22
HYDRAULIC LENGTH                       (m.)       :     102.10
PERCENT FOREST                          (%)       :        .00
PERCENT AGRICULTURE                     (%)       :        .00
PERCENT GRASSLAND                       (%)       :        .00
OVERLAND FLOW SLOPE                     (%)       :      10.91
CHANNEL SLOPE                           (%)       :        .01
CHANNEL LENGTH FROM SUBWATERSHED       (m.)       :        .00
TYPE OF CHANNEL FROM SUBWATERSHED                 :AN UNLINED CHANNEL
CORRECTION FACTOR FOR IMPERVIOUS AREA             :       1.00
CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS        :       1.00
AREAL REDUCTION FACTOR                            :       1.00



SEDIMENT PARAMETERS
-------------------

THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

=========================================================================
```

********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.0	.0	.0	.0	.1	.1	.1
12.0 *	.1	.0	.0	.0	.0	.0	.0	.0		

INITIAL ABSTRACTION	=	10.55	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.00	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	153.10	mm.
VOLUME OF RUNOFF	=	.34	thousand cu.m.
PEAK RUNOFF RATE	=	.12	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

==

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

==

```
========================================================================

     *****************************************************************
     SUBWATERSHED CONDITIONS AT SUB-9
     *****************************************************************

     RAINFALL PARAMETERS
     -------------------

     SCS CURVE NUMBER                                  :  82.80
     UNIT HYDROGRAPH SELECTED                          :  HAANS

     MAP PARAMETERS
     --------------

     AREA                                (ha.)         :        .18
     HYDRAULIC LENGTH                     (m.)         :     114.29
     PERCENT FOREST                        (%)         :        .00
     PERCENT AGRICULTURE                   (%)         :        .00
     PERCENT GRASSLAND                     (%)         :        .00
     OVERLAND FLOW SLOPE                   (%)         :      11.47
     CHANNEL SLOPE                         (%)         :       4.44
     CHANNEL LENGTH FROM SUBWATERSHED     (m.)         :      79.24
     TYPE OF CHANNEL FROM SUBWATERSHED                 :AN UNLINED CHANNEL
     CORRECTION FACTOR FOR IMPERVIOUS AREA             :       1.00
     CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS        :       1.00
     AREAL REDUCTION FACTOR                            :       1.00



     SEDIMENT PARAMETERS
     -------------------

     THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

========================================================================
```

********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.1	.1
12.0 *	.1									

INITIAL ABSTRACTION	=	10.55	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.00	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	153.10	mm.
VOLUME OF RUNOFF	=	.28	thousand cu.m.
PEAK RUNOFF RATE	=	.09	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

===

****
SUBWATERSHED CONDITIONS AT SUB-9A
****

RAINFALL PARAMETERS

SCS CURVE NUMBER		:	82.80
UNIT HYDROGRAPH SELECTED		:	HAANS

MAP PARAMETERS

AREA	(ha.)	:	.12
HYDRAULIC LENGTH	(m.)	:	80.77
PERCENT FOREST	(%)	:	.00
PERCENT AGRICULTURE	(%)	:	.00
PERCENT GRASSLAND	(%)	:	.00
OVERLAND FLOW SLOPE	(%)	:	10.19
CHANNEL SLOPE	(%)	:	5.28
CHANNEL LENGTH FROM SUBWATERSHED	(m.)	:	170.68
TYPE OF CHANNEL FROM SUBWATERSHED		:	AN UNLINED CHANNEL
CORRECTION FACTOR FOR IMPERVIOUS AREA		:	1.00
CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS		:	1.00
AREAL REDUCTION FACTOR		:	1.00

SEDIMENT PARAMETERS

THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

===

********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1
12.0 *	.1									

INITIAL ABSTRACTION	=	10.55	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.00	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	153.10	mm.
VOLUME OF RUNOFF	=	.18	thousand cu.m.
PEAK RUNOFF RATE	=	.06	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

===

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

===

==

****
SUBWATERSHED CONDITIONS AT SUB-10
****

RAINFALL PARAMETERS

SCS CURVE NUMBER		:	82.80
UNIT HYDROGRAPH SELECTED		:	HAANS

MAP PARAMETERS

AREA	(ha.)	:	.23
HYDRAULIC LENGTH	(m.)	:	141.73
PERCENT FOREST	(%)	:	.00
PERCENT AGRICULTURE	(%)	:	.00
PERCENT GRASSLAND	(%)	:	.00
OVERLAND FLOW SLOPE	(%)	:	7.26
CHANNEL SLOPE	(%)	:	4.21
CHANNEL LENGTH FROM SUBWATERSHED	(m.)	:	228.59
TYPE OF CHANNEL FROM SUBWATERSHED		:	AN UNLINED CHANNEL
CORRECTION FACTOR FOR IMPERVIOUS AREA		:	1.00
CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS		:	1.00
AREAL REDUCTION FACTOR		:	1.00

SEDIMENT PARAMETERS

THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

==

********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.0	.0	.0	.0	.1	.1	.1
12.0 *	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0

INITIAL ABSTRACTION	=	10.55	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.00	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	153.10	mm.
VOLUME OF RUNOFF	=	.35	thousand cu.m.
PEAK RUNOFF RATE	=	.12	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

==

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

==

==

****
SUBWATERSHED CONDITIONS AT SUB-11
****

RAINFALL PARAMETERS

SCS CURVE NUMBER		:	82.80
UNIT HYDROGRAPH SELECTED		:	HAANS

MAP PARAMETERS

AREA	(ha.)	:	.54
HYDRAULIC LENGTH	(m.)	:	190.49
PERCENT FOREST	(%)	:	.00
PERCENT AGRICULTURE	(%)	:	.00
PERCENT GRASSLAND	(%)	:	.00
OVERLAND FLOW SLOPE	(%)	:	6.80
CHANNEL SLOPE	(%)	:	.01
CHANNEL LENGTH FROM SUBWATERSHED	(m.)	:	.00
TYPE OF CHANNEL FROM SUBWATERSHED		:	AN UNLINED CHANNEL
CORRECTION FACTOR FOR IMPERVIOUS AREA		:	1.00
CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS		:	1.00
AREAL REDUCTION FACTOR		:	1.00

SEDIMENT PARAMETERS

THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

==

********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.0	.0	.0	.0	.1	.2	.2
12.0 *	.3	.1	.0	.0	.0	.0	.0	.0	.0	.0
13.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
14.0 *	.0									

INITIAL ABSTRACTION	=	10.55	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.00	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	153.10	mm.
VOLUME OF RUNOFF	=	.83	thousand cu.m.
PEAK RUNOFF RATE	=	.28	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

==

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

==

C62

===

****
SUBWATERSHED CONDITIONS AT SUB-12
****

RAINFALL PARAMETERS

SCS CURVE NUMBER		:	82.80
UNIT HYDROGRAPH SELECTED		:	HAANS

MAP PARAMETERS

AREA	(ha.)	:	.65
HYDRAULIC LENGTH	(m.)	:	281.93
PERCENT FOREST	(%)	:	.00
PERCENT AGRICULTURE	(%)	:	.00
PERCENT GRASSLAND	(%)	:	.00
OVERLAND FLOW SLOPE	(%)	:	6.81
CHANNEL SLOPE	(%)	:	1.75
CHANNEL LENGTH FROM SUBWATERSHED	(m.)	:	160.01
TYPE OF CHANNEL FROM SUBWATERSHED		:	AN UNLINED CHANNEL
CORRECTION FACTOR FOR IMPERVIOUS AREA		:	1.00
CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS		:	1.00
AREAL REDUCTION FACTOR		:	1.00

SEDIMENT PARAMETERS

THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

===

********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.0	.0	.1	.1	.2	.2	.3
12.0 *	.3	.1	.0	.0	.0	.0	.0	.0	.0	.0
13.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
14.0 *	.0	.0	.0	.0	.0	.0	.0	.0		

INITIAL ABSTRACTION	=	10.55	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.00	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	153.10	mm.
VOLUME OF RUNOFF	=	.99	thousand cu.m.
PEAK RUNOFF RATE	=	.34	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

==

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

==

==

****
SUBWATERSHED CONDITIONS AT SUB-13
****

RAINFALL PARAMETERS

SCS CURVE NUMBER		:	82.80
UNIT HYDROGRAPH SELECTED		:	HAANS

MAP PARAMETERS

AREA	(ha.)	:	.26
HYDRAULIC LENGTH	(m.)	:	124.96
PERCENT FOREST	(%)	:	.00
PERCENT AGRICULTURE	(%)	:	.00
PERCENT GRASSLAND	(%)	:	.00
OVERLAND FLOW SLOPE	(%)	:	8.89
CHANNEL SLOPE	(%)	:	2.88
CHANNEL LENGTH FROM SUBWATERSHED	(m.)	:	411.46
TYPE OF CHANNEL FROM SUBWATERSHED		:	AN UNLINED CHANNEL
CORRECTION FACTOR FOR IMPERVIOUS AREA		:	1.00
CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS		:	1.00
AREAL REDUCTION FACTOR		:	1.00

SEDIMENT PARAMETERS

THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

==

********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.0	.0	.0	.0	.1	.1	.1
12.0 *	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0
13.0 *	.0	.0	.0	.0						

INITIAL ABSTRACTION	=	10.55	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.05	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	153.10	mm.
VOLUME OF RUNOFF	=	.40	thousand cu.m.
PEAK RUNOFF RATE	=	.14	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

==

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

==

==

****
SUBWATERSHED CONDITIONS AT SUB-14
****

RAINFALL PARAMETERS

SCS CURVE NUMBER	:	82.80
UNIT HYDROGRAPH SELECTED	:	HAANS

MAP PARAMETERS

AREA	(ha.)	:	.38
HYDRAULIC LENGTH	(m.)	:	164.58
PERCENT FOREST	(%)	:	.00
PERCENT AGRICULTURE	(%)	:	.00
PERCENT GRASSLAND	(%)	:	.00
OVERLAND FLOW SLOPE	(%)	:	6.38
CHANNEL SLOPE	(%)	:	2.53
CHANNEL LENGTH FROM SUBWATERSHED	(m.)	:	505.94
TYPE OF CHANNEL FROM SUBWATERSHED		:	AN UNLINED CHANNEL
CORRECTION FACTOR FOR IMPERVIOUS AREA		:	1.00
CORRECTION FACTOR FOR CHANNEL IMPROVEMENTS		:	1.00
AREAL REDUCTION FACTOR		:	1.00

SEDIMENT PARAMETERS

THERE IS NO SEDIMENT DATA FOR THIS SUBWATERSHED

==

********** STORM HYDROGRAPH GENERATED FROM START OF RAINFALL ***********

TIME *	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
11.0 *	.0	.0	.0	.0	.0	.0	.0	.1	.1	.2
12.0 *	.2	.1	.0	.0	.0	.0	.0	.0	.0	.0
13.0 *	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

INITIAL ABSTRACTION	=	10.55	mm.
ROUTED FLOW TIME FROM THE SUBWATERSHED	=	.05	hours.
TIME TO PEAK OF UNIT HYDROGRAPH	=	.05	hours.
THE DEPTH OF WATER ON WATERSHED	=	153.10	mm.
VOLUME OF RUNOFF	=	.58	thousand cu.m.
PEAK RUNOFF RATE	=	.20	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.

==

THERE IS NO SEDIMENT CONTAINED IN THE STORM RUNOFF FROM THIS WATERSHED

==

C68

STORM HYDROGRAPH FOR WATERSHED RECLAIMED HEAP

TOTAL AREA OF THE WATERSHED	=	2.58	ha.
THE DEPTH OF WATER ON WATERSHED	=	153.10	mm.
VOLUME OF RUNOFF	=	3.95	thousand cu.m.
PEAK RUNOFF RATE	=	1.35	cu. m./sec.
TIME TO PEAK RUNOFF	=	12.05	hours.
TIME INCREMENT OF NEW HYDROGRAPH	=	.10	hours.
NUMBER OF RUNOFF VALUES	=	187	

******* STORM HYDROGRAPH GENERATED FROM START OF RUNOFF *******

.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.1	.1	.1	.1	.2	.2
.7	.8	1.3	1.3	.2	.1	.1	.1	.1	.1
.1	.1	.1	.1	.1	.1	.1	.1	.1	.1
.1	.1	.1	.1	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.0	.0	.0	.0	.0	.0	.0			

APPENDIX D
RIPRAP SIZING CALCULATIONS

STEFFEN ROBERTSON & KIRSTEN (U.S.) Consulting Engineers & Scientists	PROJECT: BARITE HILL	NO. 14115
	CALCULATED BY: PEK	DATE: 4/4/95
	CHECKED BY:	DATE:
	SHEET 1 OF	

RIPRAP SIZING CALCULATIONS

THE FOLLOWING PROCEDURE WAS USED TO SIZE THE RIPRAP CHANNEL LINING SIZE

1. PEAK FLOWS WERE DETERMINED USING A WORST CASE SCENARIO OF THE 100-YR 24-HR STORM (8") OCCURRING OVER THE ENTIRE HEAP WHILE THE ENTIRE HEAP IS COVERED WITH TOPSOIL, BUT BEFORE VEGETATION HAS BEEN ESTABLISHED

2. AN INITIAL ESTIMATE OF RIPRAP SIZE WAS MADE BASED ON PEAK FLOW AND CHANNEL SLOPE. USING A RELATIONSHIP DEVELOPED BY ABT, WITTLER, RUFF, AND KHATTAK (1988), MANNING'S n WAS ESTIMATED FOR EACH CHANNEL REACH.

$$n = 0.0456\left(D_{50} \cdot S\right)^{0.159}$$

n = MANNING'S ROUGHNESS COEFFICIENT
D_{50} = ROCK SIZE, INCHES, FOR WHICH 50% IS SMALLER
S = SLOPE, FT/FT

3. USING THE ESTIMATE OF n OBTAINED BY USING THE ABOVE EQUATION, FLOW DEPTHS AND VELOCITIES WERE COMPUTED USING THE PROGRAM, FLOWMASTER, WHICH UTILIZES THE MANNING EQUATION.

4. FOUR DIFFERENT METHODS FOR DETERMINING RIPRAP SIZE WERE UTILIZED IN ORDER TO DETERMINE A RANGE OF VALUES FOR THE RIPRAP d_{50} SIZE.

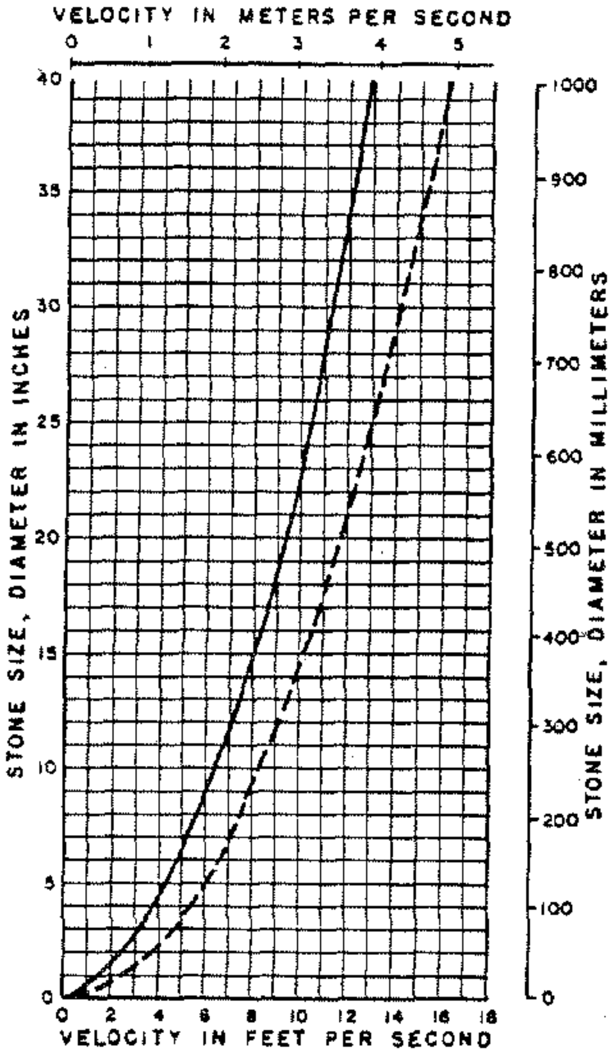
THE FOUR METHODS USED WERE:

I DRCOG (1969) → URBAN STORM DRAINAGE CRITERIA MANUAL, DENVER REGIONAL COUNCIL OF GOVERNMENTS, 1969.

II. USBR (1978) → U.S. BUREAU OF RECLAMATION FROM HYDRAULIC DESIGN OF STILLING BASIN FOR PIPE OR CHANNEL OUTLETS, WATER RESOURCES TECHNICAL PUBLICATION, RESEARCH REPORT No. 24, U.S. DEPT OF INTERIOR, 1978

III. FHWA (1967) → FHWA METHOD IN "USE OF RIPRAP FOR BANK PROTECTION", HYDRAULIC ENGINEERING CIRCULAR No. 11, U.S. DEPT OF TRANSPORTATION, FEDERAL HIGHWAY ADMINISTRATION, WASHINGTON, D.C. JUNE 1967.

IV. ANDERSON (1973) → "TENTATIVE DESIGN PROCEDURE FOR RIPRAP-LINED CHANNELS - FIELD EVALUATION"; NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM PROJECT 15-2, UNIVERSITY OF MINNESOTA, MINNEAPOLIS, MINNESOTA



Note: The riprap should be composed of a well-graded mixture but most of the stones should be of the size indicated by the curve.

—— End sill velocity in type VI Basin vs stone size required in riprap.

---- Bottom velocity in a channel vs stone size required in riprap. (See figure 165 in reference 2)

Figure 15.–Recommended riprap stone size.

FOR USE IN USBR (1978) METHOD

Figure 1

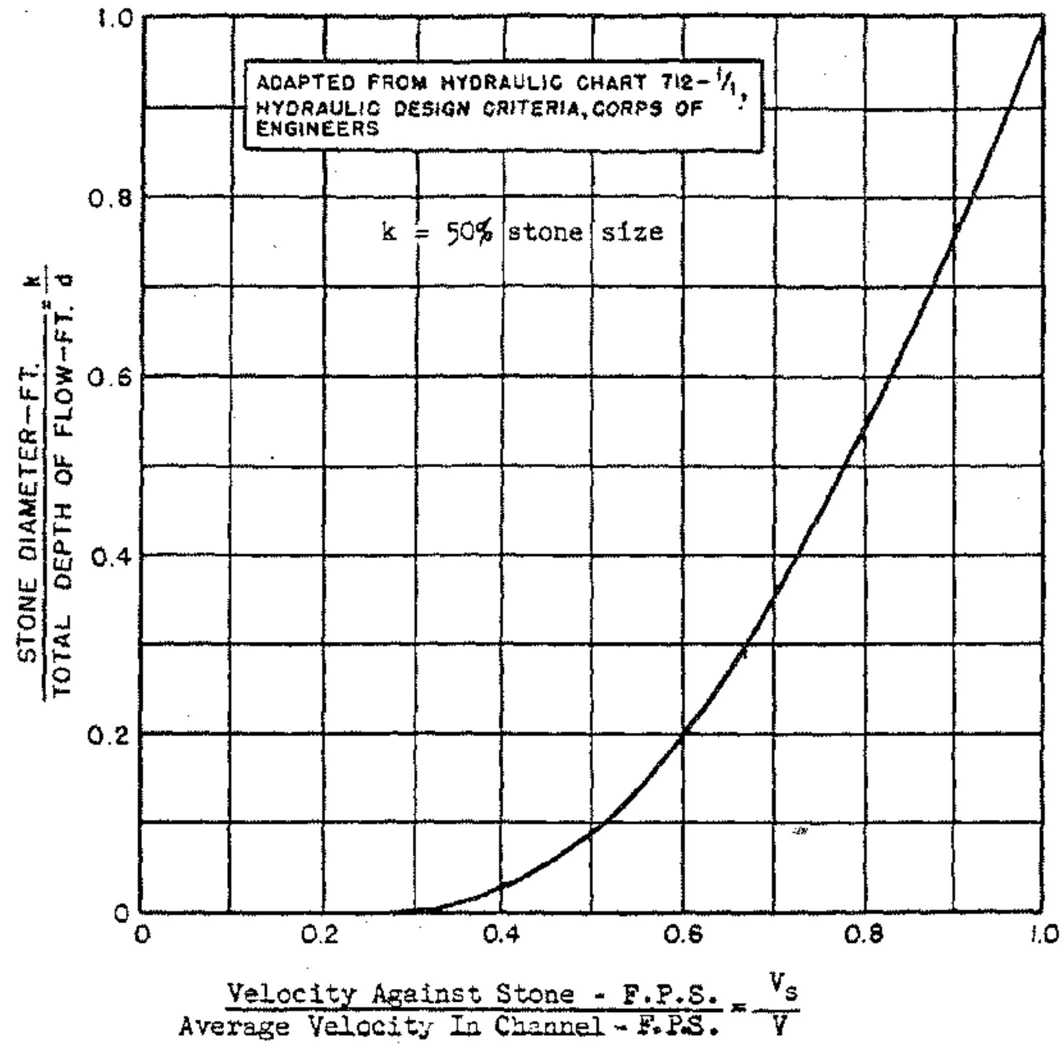


FIG. 1 - VELOCITY AGAINST STONE ON CHANNEL BOTTOM

The size of stone required to resist displacement from direct impingement of the current as might occur with a sharp change in stream alinement is greater than the value obtained from figure 2, although research data is lacking on just how much larger the stone should be. The California Division of Highways (6) recommends doubling the velocity against the stone as determined for straight alinement before entering figure 2 for stone size. Lane (9) recommends reducing the allowable velocity by 22 percent for very sinuous channels; for determining stone size by figure 2, the velocity (V_s) would be increased by 22 percent. Until data are available for determining the stone size at the point of impingement, a factor which would vary from 1 to 2 depending upon the severity of the attack by the current, should be applied to the velocity V_s before entering figure 2.

FOR USE IN
FHWA (1967)
METHOD

D4

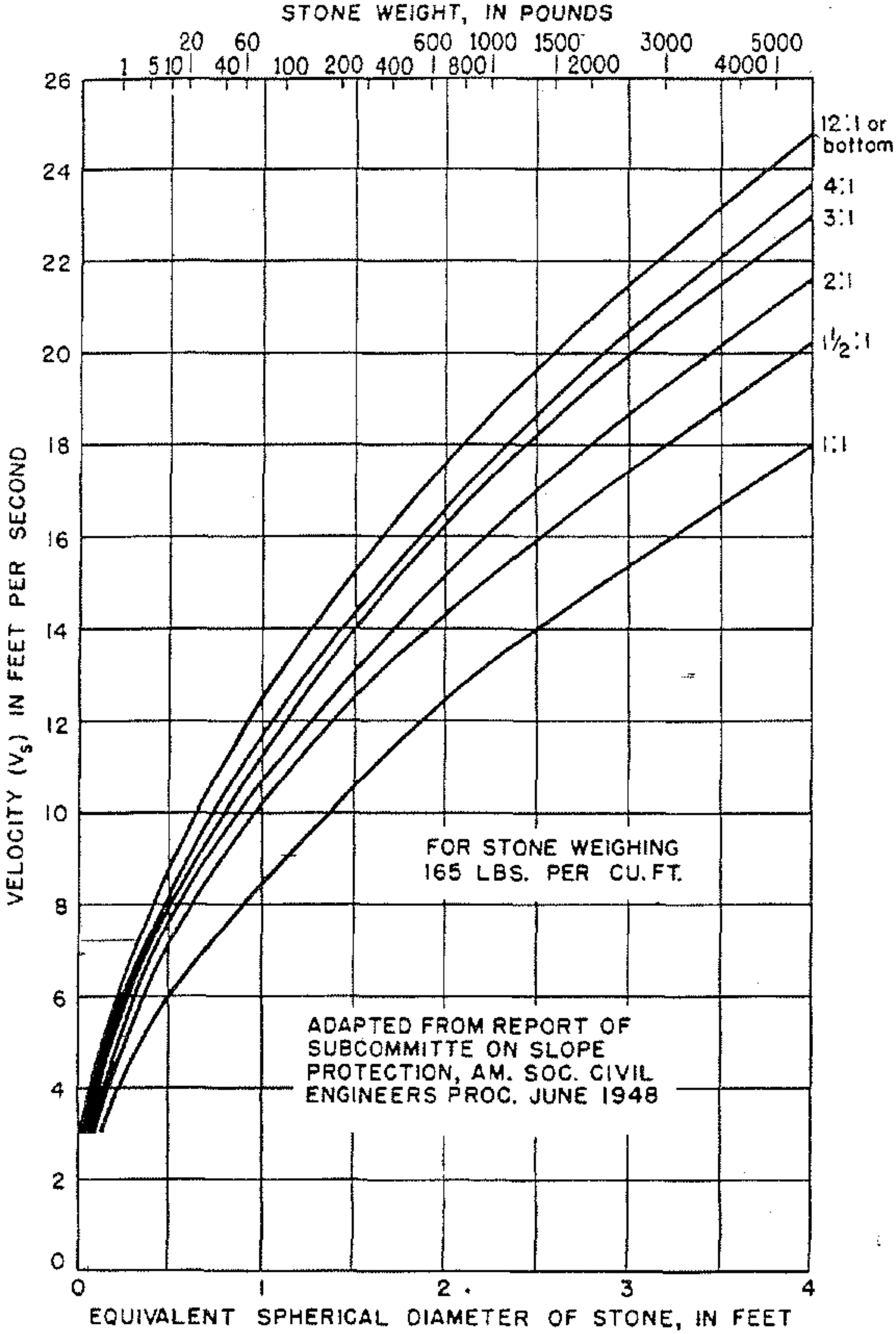


FIG. 2-SIZE OF STONE THAT WILL RESIST DISPLACEMENT FOR VARIOUS VELOCITIES AND SIDE SLOPES

FOR USE IN FHWA (1967) METHOD

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: BARITE HILL

Comment: UPPER SPILLWAY - d50 = 12"

Solve For Depth

Given Input Data:

Bottom Width.....	10.00 ft
Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.056
Channel Slope....	0.3120 ft/ft
Discharge........	30.37 cfs

Computed Results:

Depth............	0.38 ft
Velocity.........	7.22 fps
Flow Area........	4.21 sf
Flow Top Width...	12.27 ft
Wetted Perimeter.	12.39 ft
Critical Depth...	0.62 ft
Critical Slope...	0.0575 ft/ft
Froude Number....	2.17 (flow is Supercritical)

Open Channel Flow Module, Version 3.16 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

STEFFEN ROBERTSON & KIRSTEN (U.S.) Consulting Engineers & Scientists	PROJECT: BARITE HILL	NO. 14115
	CALCULATED BY: FFL	DATE: 4/4/95
	CHECKED BY:	DATE:
	SHEET 6 OF	

RIPRAP SIZING FOR UPPER SPILLWAY

SPILLWAY IS TRAPEZOIDAL w/ 10 FT BOTTOM, 3:1 (H:V) SIDE SLOPES

$Q_{PEAK} = 30.37$ CFS

$V = 7.22$ FPS @ 31.2%

I DRCOG (1969)

$$d_{50} = \left[\frac{VS^{0.17}}{(S_s-1)^{0.66} 4.5}\right]^2$$

$$d_{50} = \left[\frac{(7.22)(0.312)^{0.17}}{(1.65)^{0.66}(4.5)}\right]^2$$

$d_{50} = 0.895$ FT $= 10.73$ INCHES $\underline{\underline{d_{50} = 10.73 \text{ INCHES}}}$

II. USBR (1978)

VELOCITY $= 7.22$ FPS $\Rightarrow$ $\underline{\underline{d_{50} = 7.5 \text{ INCHES}}}$

III. FHWA (1967)

ASSUME $d_{50} = 12'' = 1$ FT (k) $\frac{k}{d} = 2.63$ [OFF CHART]

DEPTH OF FLOW $= 0.38$ FT (d)

ASSUME $\frac{V_s}{V} = 1.5 \Rightarrow V_s = 1.5V = 10.83$ FPS

$d_{50} = 0.8$ FT $= 9.6$ INCHES $\Rightarrow$ $\underline{\underline{d_{50} = 12'' \text{ IS ADEQUATE}}}$

IV. ANDERSON (1973)

$$d_{50} = \left[\frac{VS^{1/6}}{4.6}\right]^2$$

$$d_{50} = \left[\frac{(7.22)(0.312)^{1/6}}{4.6}\right]$$

$\underline{\underline{d_{50} = 20.05 \text{ INCHES}}}$

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: BARITE HILL

Comment: LOWER SPILLWAY - d50 = 18"

Solve For Depth

Given Input Data:

```
Bottom Width.....    10.00 ft
Left Side Slope..     3.00:1 (H:V)
Right Side Slope.     3.00:1 (H:V)
Manning's n......     0.060
Channel Slope....     0.3120 ft/ft
Discharge........    87.24 cfs
```

Computed Results:

```
Depth............     0.72 ft
Velocity.........     9.89 fps
Flow Area........     8.82 sf
Flow Top Width...    14.35 ft
Wetted Perimeter.    14.58 ft
Critical Depth...     1.18 ft
Critical Slope...     0.0553 ft/ft
Froude Number....     2.22 (flow is Supercritical)
```

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RIPRAP SIZING FOR LOWER SPILLWAY

SPILLWAY IS TRAPEZOIDAL w/ 10 FT BOTTOM, 3:1 (H:V) SIDE SLOPES

Q_{PEAK} = 87.24 CFS

V = 9.89 FPS @ 31.2%

I DRCOG (1969)

$$d_{50} = \left[\frac{VS^{0.17}}{(S_s-1)^{0.66} 4.5}\right]^2$$

$$d_{50} = \left[\frac{(9.89)(0.312)^{0.17}}{1.65^{0.66}(4.5)}\right]^2$$

d_{50} = 20.14 INCHES

II USBR (1978)

VELOCITY = 9.89 FPS ⇒ d_{50} = 14 INCHES

III FHWA (1967)

ASSUME d_{50} = 18" = 1.5 FT (k)

DEPTH OF FLOW = 0.72 FT (d)

$\frac{k}{d} = 2.1$

ASSUME $\frac{V_s}{V} = 1.5$ $V_s = 1.5V = 14.8$ FPS

d_{50} = 19.2 INCHES

IV. ANDERSON (1973)

$$d_{50} = \left[\frac{VS^{1/6}}{4.6}\right]^2$$

$$d_{50} = \left[\frac{9.89(0.312)^{1/6}}{4.6}\right]^2$$

d_{50} = 37.6 INCHES

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: BARITE HILL

Comment: EAST CORNER - ON BENCH d50 = 8"

Solve For Depth

Given Input Data:

Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.045
Channel Slope....	0.1074 ft/ft
Discharge........	22.06 cfs

Computed Results:

Depth............	1.04 ft
Velocity.........	6.82 fps
Flow Area........	3.23 sf
Flow Top Width...	6.23 ft
Wetted Perimeter.	6.57 ft
Critical Depth...	1.27 ft
Critical Slope...	0.0360 ft/ft
Froude Number....	1.67 (flow is Supercritical)

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	SHEET 10 OF	

RIPRAP SIZING FOR PORTIONS OF DITCHES ON OR NEAR THE HEAP

DITCH ON EAST CORNER OF HEAP - ON BENCH

DITCH IS TRIANGULAR, 3:1 H:V SIDE SLOPES

$Q_{PEAK} = 22.06$ CFS

$V = 6.82$ FPS @ 10.74% SLOPE

I DRCOG (1969)

$$\frac{VS^{0.17}}{d_{50}^{0.5}(S_s-1)^{0.66}} = 4.5$$

V = MEAN CHANNEL VELOCITY, FPS
S = CHANNEL SLOPE, FT/FT
S_s = SPECIFIC GRAVITY OF ROCK
d_{50} = ROCK SIZE, FT, FOR WHICH 50% IS SMALLER

$$d_{50} = \left[\frac{V\,S^{0.17}}{(S_s-1)^{0.66}(4.5)}\right]^2$$

$$d_{50} = \frac{(6.82)(0.1074\ \text{FT/FT})^{0.17}}{(1.65)^{0.66}\ 4.5}$$

$d_{50} = 8.94$ INCHES

II USBR (1978)

VELOCITY = 6.82 FPS ⇒ $d_{50} \cong 6.25$ INCHES

III FHWA METHOD (1967)

ASSUME $d_{50} = 8'' = 0.67$ FT (k) $\frac{k}{d} = 0.644$ SAY 0.65

DEPTH OF FLOW = 1.04 FT (d)

$\frac{V_s}{V} = 0.85 \Rightarrow V_s = 0.85V = 0.85(6.82\ \text{FPS}) = 5.797$ FPS

$d_{50} \cong 0.25$ FT = 3 $d_{50} = 3$ INCHES ⇒ ∴ $d_{50} = 8''$ IS ADEQUATE

IV ANDERSON (1973)

$$d_{50} = \left[\frac{VS^{1/6}}{4.6}\right]^2$$

$d_{50} = 12.5$ INCHES

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: BARITE HILL

Comment: EAST CORNER - ON GROUND = 8"

Solve For Depth

Given Input Data:

Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.041
Channel Slope....	0.0667 ft/ft
Discharge........	25.00 cfs

Computed Results:

Depth............	1.15 ft
Velocity.........	6.26 fps
Flow Area........	3.99 sf
Flow Top Width...	6.92 ft
Wetted Perimeter.	7.30 ft
Critical Depth...	1.34 ft
Critical Slope...	0.0301 ft/ft
Froude Number....	1.45 (flow is Supercritical)

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	CALCULATED BY:	DATE:
	CHECKED BY:	DATE:
	SHEET 12 OF	

DITCH ON EAST CORNER OF HEAP – ON GROUND

DITCH IS TRIANGULAR, 3:1 H:V SIDE SLOPES

$Q_{PEAK} \doteq 25$ CFS

$V = 6.26$ FPS @ 6.67% SLOPE

I DRCOG (1969)

$$\frac{VS^{0.17}}{d_{50}^{0.5}(S_s-1)^{0.66}} = 4.5$$

$$d_{50} = \left[\frac{VS^{0.17}}{(S_s-1)^{0.66}4.5}\right]$$

$$d_{50} = \left[\frac{(6.26)(0.0667)^{0.17}}{(1.65)^{0.66}\,4.5}\right]$$

$d_{50} = 0.63$ FT $\doteq 7.6$ INCHES

$d_{50} \doteq 7.6$ INCHES

II USER (1978)

VELOCITY = 6.26 FPS $\Rightarrow$ $d_{50} \doteq 5.25$ INCHES

III. FHWA (1967)

ASSUME $d_{50} = 6'' = 0.5$ FT (k) $\quad \frac{k}{d} = \frac{0.5}{1.15} = 0.434$ SAY 0.45

DEPTH OF FLOW = 1.15 FT (d)

$\frac{V_s}{V} = 0.75 \Rightarrow V_s = 0.75V = 0.75(6.26\text{ FPS}) = 4.695$ FPS

$d_{50} \doteq 0.25$ FT

$d_{50} = 3$ INCHES $\Rightarrow \therefore d_{50} = 6''$ IS ADEQUATE.

IV ANDERSON (1973)

$$d_{50} = \left[\frac{VS^{1/6}}{4.6}\right]^2$$

$d_{50} \doteq 9$ INCHES

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: BARITE HILL

Comment: EAST CORNER - ON GROUND = 10"

Solve For Depth

Given Input Data:

Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.051
Channel Slope....	0.2000 ft/ft
Discharge........	25.00 cfs

Computed Results:

Depth............	1.02 ft
Velocity.........	8.03 fps
Flow Area........	3.12 sf
Flow Top Width...	6.11 ft
Wetted Perimeter.	6.44 ft
Critical Depth...	1.34 ft
Critical Slope...	0.0465 ft/ft
Froude Number....	1.98 (flow is Supercritical)

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SHEET 14 OF	

DITCH ON EAST CORNER OF HEAP - ON GROUND - @ 20%

DITCH IS TRIANGULAR, 3:1 H:V SIDE SLOPES

$Q_{PEAK} \doteq 25$ CFS

$V = 8.03$ FPS @ 20%

I DRCOG (1969)

$$\frac{VS^{0.17}}{d_{50}^{0.5}(S_s-1)^{0.66}} = 4.5$$

V = MEAN CHANNEL VELOCITY, FPS
S = CHANNEL SLOPE, FT/FT
S_s = SPECIFIC GRAVITY OF ROCK
d_{50} = ROCK SIZE, FT, FOR WHICH 50% IS SMALLER

$$d_{50} = \left[\frac{VS^{0.17}}{(S_s-1)^{0.66}(4.5)}\right]^2$$

$$d_{50} = \left[\frac{(8.03)(0.200)^{0.17}}{(1.65)^{0.66}\,(4.5)}\right]^2$$

d_{50} = 11.4 INCHES

II USBR (1978)

VELOCITY = 8.03 FPS ⇒ $d_{50} \doteq 9$ INCHES

III FHWA (1967)

ASSUME d_{50} = 10" = 0.833 FT (k) $\frac{k}{d} = 0.816$
DEPTH OF FLOW = 1.02 FT (d)

$\frac{V_s}{V} = 0.92 \Rightarrow V_s = 0.92V = 0.92(8.03) = 7.39$ FPS

$d_{50} \doteq 0.4$ FT = 4.8 INCHES

d_{50} = 4.8 INCHES
∴ d_{50} = 10" IS ADEQUATE

IV ANDERSON (1973)

$$d_{50} = \left[\frac{VS^{1/6}}{4.6}\right]^2$$

$$d_{50} = \left[\frac{(8.03)(0.20)^{1/6}}{4.6}\right]^2$$

d_{50} = 21.4 INCHES

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: BARITE HILL

Comment: SOUTH CORNER - ON BENCH - d50 = 6"

Solve For Depth

Given Input Data:

Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.041
Channel Slope....	0.0889 ft/ft
Discharge........	17.31 cfs

Computed Results:

Depth............	0.95 ft
Velocity.........	6.36 fps
Flow Area........	2.72 sf
Flow Top Width...	5.71 ft
Wetted Perimeter.	6.02 ft
Critical Depth...	1.16 ft
Critical Slope...	0.0316 ft/ft
Froude Number....	1.62 (flow is Supercritical)

Open Channel Flow Module, Version 3.16 (c) 1990
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DITCH ON SOUTH CORNER – ON BENCH – @ 8.89%

DITCH IS TRIANGULAR, 3:1 H:V SIDE SLOPES

$Q_{PEAK} = 17.31$ CFS

$V = 6.36$ FPS @ 8.89%

I DRCOG (1969)

$$d_{50} = \left[\frac{VS^{0.17}}{(S_s-1)^{0.66}\,4.5}\right]^2$$

$\underline{\underline{d_{50} = 5.4 \text{ INCHES}}}$

II USBR (1978)

VELOCITY = 6.36 FPS $\Rightarrow$ $\underline{\underline{d_{50} \doteq 6 \text{ INCHES}}}$

III FHWA METHOD (1967)

ASSUME $d_{50} = 6'' = 0.5$ FT (k) $\qquad \frac{k}{d} = 0.53$

DEPTH OF FLOW = 0.95 FT (d)

$\frac{V_s}{V} = 0.78 \Rightarrow V_s = 0.78V \Rightarrow V_s = 4.96$ FPS

$d_{50} \doteq 0.25$ FT = 3 INCHES

$\underline{\underline{d_{50} = 3 \text{ INCHES}}} \Rightarrow \therefore \underline{\underline{d_{50} = 6'' \text{ IS ADEQUATE}}}$

IV ANDERSON (1973)

$$d_{50} = \left[\frac{VS^{1/6}}{4.6}\right]^2$$

$$d_{50} = \left[\frac{(6.36)(0.0889)^{1/6}}{4.6}\right]^2$$

$\underline{\underline{d_{50} = 10.2 \text{ INCHES}}}$

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: BARITE HILL

Comment: SOUTH CORNER - ON GROUND d50 = 4"

Solve For Depth

Given Input Data:

Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.034
Channel Slope....	0.0400 ft/ft
Discharge........	7.06 cfs

Computed Results:

Depth............	0.74 ft
Velocity.........	4.34 fps
Flow Area........	1.63 sf
Flow Top Width...	4.42 ft
Wetted Perimeter.	4.66 ft
Critical Depth...	0.81 ft
Critical Slope...	0.0245 ft/ft
Froude Number....	1.26 (flow is Supercritical)

Ditch on south corner – on ground @ 4%

Ditch is triangular, 3:1 H:V side slopes

$Q_{PEAK} = 7.06$ cfs

$V = 4.34$ fps

I DRCOG (1969)

$$d_{50} = \left[\frac{VS^{0.17}}{(S_s-1)^{0.66}\, 4.5}\right]^2$$

$$d_{50} = \left[\frac{(4.34)(0.04)^{0.17}}{(1.65)^{0.66}\, 4.5}\right]^2$$

$d_{50} = 0.16$ ft $\cong$ 2 inches

$\underline{\underline{d_{50} \cong 2 \text{ inches}}}$

II USBR (1978)

Velocity = 4.34 fps $\Rightarrow$ $\underline{\underline{d_{50} \cong 2.75 \text{ inches}}}$

III. FHWA Method (1967)

Assume $d_{50} = 4'' = 0.333$ ft (k) $\frac{k}{d} = 0.45$

Depth of flow = 0.74 ft (d)

$\frac{V_s}{V} = 0.75 \Rightarrow V_s = 0.75V = 3.26$ fps

$d_{50} < 0.25$ ft

$\underline{\underline{d_{50} < 3 \text{ inches}}} \Rightarrow \therefore$ $\underline{\underline{d_{50} = 4'' \text{ is adequate}}}$

IV. Anderson (1973)

$$d_{50} = \left[\frac{VS^{1/6}}{4.6}\right]^2$$

$$d_{50} = \left[\frac{(4.34)(0.04)^{1/6}}{4.6}\right]^2$$

$d_{50} = 0.30$ ft $= 3.65$ inches

$\underline{\underline{d_{50} = 3.65 \text{ inches}}}$

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: BARITE HILL

Comment: SOUTH CORNER - ON GROUND d50 = 6"

Solve For Depth

Given Input Data:

Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.042
Channel Slope....	0.1000 ft/ft
Discharge........	10.59 cfs

Computed Results:

Depth............	0.78 ft
Velocity.........	5.78 fps
Flow Area........	1.83 sf
Flow Top Width...	4.69 ft
Wetted Perimeter.	4.94 ft
Critical Depth...	0.95 ft
Critical Slope...	0.0354 ft/ft
Froude Number....	1.63 (flow is Supercritical)

Open Channel Flow Module, Version 3.16 (c) 1990
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DITCH ON SOUTH CORNER – ON GROUND @ 10%

DITCH IS TRIANGULAR ; 3:1 H:V SIDESLOPES

$Q_{PEAK} = 10.59$ CFS

$V = 5.78$ FPS @ 10%

I DRCOG (1969)

$$d_{50} = \left[\frac{VS^{0.17}}{(S_s-1)^{0.66}4.5}\right]^2$$

$$d_{50} = \left[\frac{(5.78)(0.100)^{0.17}}{(1.66)^{0.66}\ 4.5}\right]^2$$

$d_{50} = 0.389$ FT $= 4.67$ INCHES $\qquad$ $d_{50} = 4.67$ INCHES

II. USBR (1978)

VELOCITY = 5.78 FPS ⇒ $d_{50} \triangleq$ 4.5 INCHES

III. FHWA METHOD (1967)

ASSUME $d_{50} = 6$ INCHES = 0.5 FT (k) $\qquad$ $\frac{k}{d} = 0.64$

DEPTH OF FLOW = 0.78 FT (d)

$\frac{V_S}{V} = 0.85 \qquad V_S = 0.85\,V = 4.91$ FPS

$d_{50} \triangleq 0.25$ FT = 3 INCHES ⇒ ∴ $d_{50} = 6''$ IS ADEQUATE

IV. ANDERSON (1973)

$$d_{50} = \left[\frac{VS^{1/6}}{4.6}\right]^2$$

$$d_{50} = \left[\frac{(5.78)(0.100)^{1/6}}{4.6}\right]^2$$

$d_{50} = 0.732$ FT = 8.8 INCHES

$d_{50} = 8.8$ INCHES

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: BARITE HILL

Comment: SOUTH CORNER - ON GROUND d50 = 6"

Solve For Depth

Given Input Data:

Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.044
Channel Slope....	0.1333 ft/ft
Discharge........	12.00 cfs

Computed Results:

Depth............	0.79 ft
Velocity.........	6.41 fps
Flow Area........	1.87 sf
Flow Top Width...	4.74 ft
Wetted Perimeter.	5.00 ft
Critical Depth...	1.00 ft
Critical Slope...	0.0382 ft/ft
Froude Number....	1.80 (flow is Supercritical)

DITCH ON SOUTH CORNER - ON GROUND @ 13.33%

DITCH IS TRIANGULAR ; 3:1 H:V SIDESLOPES

Q_{PEAK} = 12 CFS

V = 6.41 FPS @ 13.33%

I DRCOG (1969)

$$d_{50} = \left[\frac{VS^{0.17}}{(S_s-1)^{0.66}4.5}\right]^2$$

$$d_{50} = \left[\frac{(6.41)(0.1333)^{0.17}}{(1.65)^{0.66}\,4.5}\right]^2$$

d_{50} = 0.528 FT = 6.34 INCHES $\quad$ $\underline{\underline{d_{50} = 6.34 \text{ INCHES}}}$

II USBR (1978)

VELOCITY = 6.41 FPS ⇒ $\underline{\underline{d_{50} = 5.5 \text{ INCHES}}}$

III. FHWA (1967)

ASSUME d_{50} = 6 INCHES = 0.5 FT (k) $\quad \frac{k}{d} = 0.63$

DEPTH OF FLOW = 0.79 FT (d)

$\frac{V_s}{V} = 0.84$ $\quad V_s = 0.84V = 5.38$ FPS

$d_{50} \doteq 0.3$ FT = $\underline{\underline{3.6 \text{ INCHES}}}$ ⇒ ∴ $\underline{\underline{d_{50} = 6'' \text{ IS ADEQUATE}}}$

IV. ANDERSON (1973)

$$d_{50} = \left[\frac{VS^{1/6}}{4.6}\right]^2$$

$$d_{50} = \left[\frac{(6.41)(0.1333)^{1/6}}{4.6}\right]^2$$

$\underline{\underline{d_{50} = 11.90 \text{ INCHES}}}$

STEFFEN ROBERTSON & KIRSTEN (U.S.) Consulting Engineers & Scientists	PROJECT: BARITE HILL	NO. 14115
	CALCULATED BY: PEK	DATE: 4/5/95
	CHECKED BY:	DATE:
	SHEET 23 OF	

RECOMMENDED RIPRAP GRADATIONS

USING SCS GRADATION RECOMMENDATION

D_{100} = 1.5 TO 2.0 × d_{50}

D_{85} = 1.3 TO 1.8 × d_{50}

D_{50} = 1.0 TO 1.5 × d_{50}

D_{15} = 0.3 TO 0.5 × d_{50}

FOR d_{50} = 4",

D_{100} = 6" - 8"

D_{85} = 5.2" - 7.2"

D_{50} = 4" - 6"

D_{15} = 1.2" - 2"

FOR d_{50} = 6",

D_{100} = 9" - 12"

D_{85} = 7.8" - 10.8"

D_{50} = 6" - 9"

D_{15} = 1.8" - 3"

FOR d_{50} = 8",

D_{100} = 12" - 16"

D_{85} = 10.4" - 14.4"

D_{50} = 8" - 12"

D_{15} = 2.4" - 4"

FOR d_{50} = 10",*

D_{100} = 15" - 20"

D_{85} = 13" - 18"

D_{50} = 10" - 15"

D_{15} = 3" - 5"

FOR d_{50} = 12",*

D_{100} = 18"-24"

D_{85} = 15.6"-21.6"

D_{50} = 12"-18"

D_{15} = 3.6"-6"

FOR d_{50} = 18",*

D_{100} = 27"-36"

D_{85} = 23.4"-32.4"

D_{50} = 18"-27"

D_{15} = 5.4"-9"

* LARGER RIPRAP SIZES CAN BE REPLACED BY GROUTED RIPRAP (USING SMALLER RIPRAP)

FILTER REQUIREMENT

$$\frac{D_{50}\,(\text{RIPRAP})}{D_{50}\,(\text{FILTER})} < 40$$

$$5 < \frac{D_{15}\,(\text{RIPRAP})}{D_{15}\,(\text{FILTER})} < 40$$

$$\frac{D_{15}\,(\text{RIPRAP})}{D_{85}\,(\text{FILTER})} < 5$$

FILTER REQUIREMENTS FROM APPLIED HYDROLOGY AND SEDIMENTOLOGY FOR DISTURBED AREAS, BARFIELD, WARNER, AND HAAN, 1981.

FOR RIPRAP d_{50} = 4"

D_{85} = 177.8 mm (USING AVG D_{85})

D_{50} = 127.0 mm

D_{15} = 40.64 mm

FILTER

D_{85} = 8.13 mm (MIN)

D_{50} = 3.175 mm (MIN)

D_{15} = 1.02 mm - 8.13 mm

FOR RIPRAP d_{50} = 6"

D_{85} = 266.7 mm

D_{50} = 190.5 mm

D_{15} = 60.96 mm

FILTER

D_{85} = 12.19 mm (MIN)

D_{50} = 4.76 mm (MIN)

D_{15} = 1.52 mm - 12.19 mm

FOR RIPRAP d_{50} = 8"

D_{85} = 355.6 mm

D_{50} = 254.0 mm

D_{15} = 81.28 mm

FILTER

D_{85} = 16.26 mm (MIN)

D_{50} = 6.35 (MIN)

D_{15} = 2.03 mm - 16.26 mm

FOR RIPRAP $d_{50} = 10''$

$D_{85} = 444.5$ mm
$D_{50} = 317.5$ mm
$D_{15} = 101.6$ mm

FILTER

$D_{85} = 20.32$ mm (MIN)
$D_{50} = 7.94$ mm (MIN)
$D_{15} = 2.54$ mm – 20.32 mm

FOR RIPRAP $d_{50} = 12''$

$D_{85} = 533.4$ mm
$D_{50} = 381.0$ mm
$D_{15} = 121.92$ mm

FILTER

$D_{85} = 24.38$ mm (MIN)
$D_{50} = 9.53$ mm (MIN)
$D_{15} = 3.05$ mm – 24.38 mm

FOR RIPRAP $d_{50} = 18''$

$D_{85} = 800.1$ mm
$D_{50} = 571.5$ mm
$D_{15} = 182.88$ mm

FILTER

$D_{85} = 36.58$ mm (MIN)
$D_{50} = 14.29$ mm (MIN)
$D_{15} = 4.57$ mm – 36.58 mm

RECOMMENDED FILTER GRADATIONS

RIPRAP $d_{50} = 4'' \rightarrow d_{50} = 8''$	RIPRAP $d_{50} = 10'' \rightarrow d_{50} = 18''$
$D_{100} = 19.05$ mm (0.75")	$D_{100} = 38.1$ mm (1.5")
$D_{85} = 16.51$ mm (0.65")	$D_{85} = 36.83$ mm (1.45")
$D_{50} = 6.35$ mm (0.25")	$D_{50} = 15.24$ mm (0.60")
$D_{15} = 2.54$ mm (0.10")	$D_{15} = 5.08$ mm (0.20")

SPILLWAY DESIGN FOR BARREN POND

SPILLWAY INVERT WILL BE 2 FEET BELOW CREST ELEVATION

SPILLWAY MUST PASS PEAK FLOW WHILE MAINTAINING 1 FOOT OF FREEBOARD IN POND

USING DISCHARGE EQUATION FOR BROAD CRESTED WEIR (SPILLWAY ENTRANCE)

$$Q = CLH^{1.5}$$

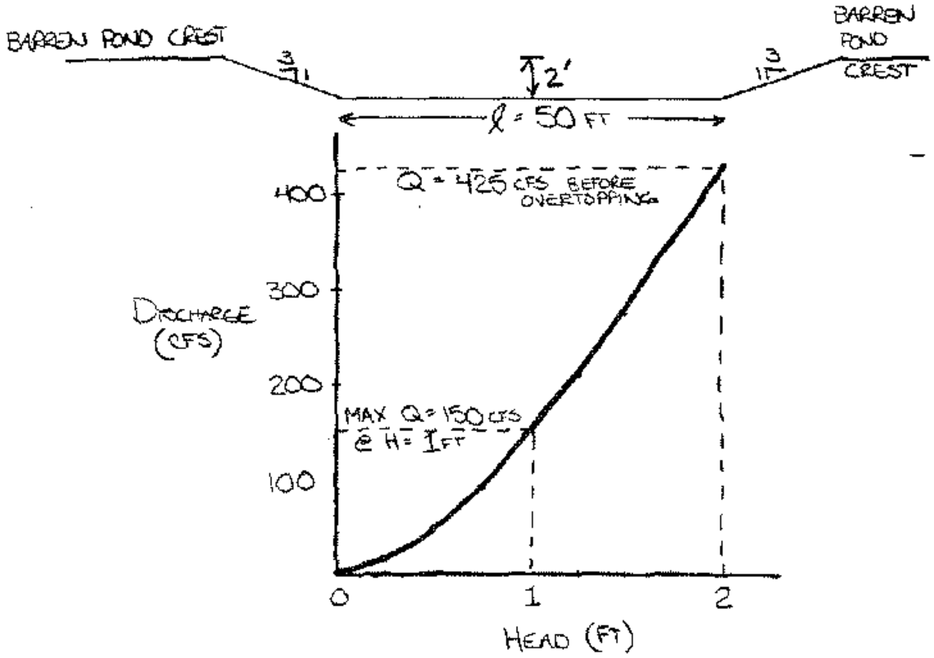
Q = FLOW, CFS
C = WEIR COEFFICIENT (USE 3.00)
L = WIDTH OF SPILLWAY ENTRANCE, FT
H = HEAD ABOVE SPILLWAY INVERT, FT [IN THIS CASE MAX H = 1 FT]

PEAK INFLOW TO POND = 139.5 CFS

ASSUMING MAX H = 1 FT, SOLVE FOR SPILLWAY WIDTH (L)

$$139.5 = (3.00)L(1)^{1.5}$$
$$139.5 = 3L$$
$$L = 46.5 \text{ FT}$$

RECOMMENDED SPILLWAY DESIGN



H (FT)	Q (CFS)
0	∅
0.25	18.75
0.50	53.03
0.75	97.43
1.00	150
1.25	209.63
1.50	275.57
1.75	347.25
2.00	424.26

STEFFEN ROBERTSON & KIRSTEN (U.S.)
Consulting Engineers & Scientists

PROJECT: BARITE HILL		NO. 14115
CALCULATED BY: PEK		DATE: 4/17/95
CHECKED BY:		DATE:
SHEET 2 OF 3		

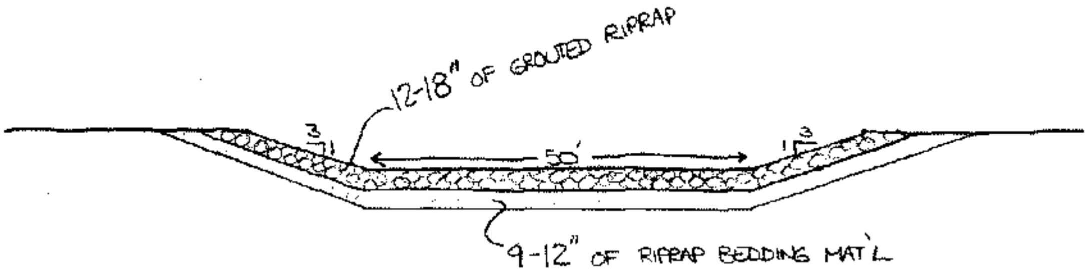
FLOW DEPTH DOWN EMBANKMENT FACE WILL BE SHALLOW (≈ 3") [SEE FLOWMASTER OUTPUT]

USE OF RIPRAP WOULD APPEAR TO BE COST PROHIBITIVE

VELOCITY IN CHANNEL ≅ 11.5 FPS

RECOMMENDED d_{50} FOR LOOSE RIPRAP ≅ 17"

RECOMMENDED CHANNEL LINING IS GROUTED RIPRAP (APPROX ~12" DURABLE ROCK)



USING GROUTED RIPRAP, AT PEAK FLOW (Q = 139.5 CFS) FLOW IN CHANNEL WILL BE AT A DEPTH OF 0.24 FT (≅ 3") AND A VELOCITY OF 11.5 FPS.

FLOW THROUGH SPILLWAY WILL BE INLET-CONTROLLED. AT PEAK FLOW DEPTH AT SPILLWAY ENTRANCE WILL BE 1 FOOT. (MAINTAINS ≤ FT FREEBOARD)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: BARITE HILL

Comment: BARREN POND SPILLWAY - USING GROUTED RIPRAP

Solve For Depth

Given Input Data:

Bottom Width.....	50.00 ft
Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.035
Channel Slope....	0.5000 ft/ft
Discharge........	139.50 cfs

Computed Results:

Depth............	0.24 ft
Velocity.........	11.47 fps
Flow Area........	12.16 sf
Flow Top Width...	51.44 ft
Wetted Perimeter.	51.52 ft
Critical Depth...	0.62 ft
Critical Slope...	0.0214 ft/ft
Froude Number....	4.16 (flow is Supercritical)

APPENDIX E
STABILITY ANALYSES

** PCSTABL5M **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 3/31/95
Time of Run: 9:00AM
Run By: MJC
Input Data Filename: BARITE1.IN
Output Filename: BARITE2.OUT

PROBLEM DESCRIPTION BARITE1.IN

BOUNDARY COORDINATES

8 Top Boundaries
15 Total Boundaries

	Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
BN0101	1	.00	435.00	40.00	435.00	2
	2	40.00	435.00	50.00	438.00	2
	3	50.00	438.00	80.00	447.00	3
	4	80.00	447.00	100.00	447.00	3
	5	100.00	447.00	200.00	480.00	1
	6	200.00	480.00	215.00	480.00	1
	7	215.00	480.00	345.00	523.00	1
	8	345.00	523.00	545.00	533.00	1
	9	101.00	447.10	200.00	449.10	4
	10	200.00	449.10	300.00	451.10	4
	11	300.00	451.10	500.00	461.10	4
	12	100.00	447.00	200.00	449.00	3
	13	200.00	449.00	300.00	451.00	2
	14	300.00	451.00	500.00	461.00	2
	15	50.00	438.00	200.00	449.00	2

1

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Total Saturated Cohesion Friction Pore Pressure Piez.

Type No.	Unit Wt. (pcf)	Unit Wt. (pcf)	Intercept (psf)	Angle (deg)	Pressure Param.	Constant (psf)	Surface No.
1	100.0	110.0	.0	34.0	.00	.0	1
2	105.0	115.0	.0	20.0	.00	.0	1
3	110.0	115.0	.0	35.0	.00	.0	1
4	100.0	100.0	.0	19.0	.00	.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 3 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	102.00	449.00
2	300.00	452.00
3	500.00	463.00

WS0102

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

Janbus Empirical Coef. is being used for the case of c & phi both > 0
900 Trial Surfaces Have Been Generated.

30 Surfaces Initiate From Each Of 30 Points Equally Spaced Along The Ground Surface Between X = 60.00 ft. and X = 200.00 ft.

Each Surface Terminates Between X = 300.00 ft. and X = 450.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y =440.00 ft.

10.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 25 Coordinate Points

FS0103

Point No.	X-Surf (ft)	Y-Surf (ft)
1	103.45	448.14
2	113.12	445.59
3	122.90	443.52
4	132.77	441.93
5	142.71	440.82
6	152.69	440.20
7	162.69	440.07
8	172.69	440.43
9	182.65	441.28
10	192.56	442.61
11	202.39	444.43
12	212.13	446.72
13	221.74	449.49
14	231.20	452.73
15	240.49	456.42
16	249.59	460.57
17	258.48	465.15
18	267.13	470.17
19	275.53	475.60
20	283.65	481.43
21	291.47	487.66
22	298.99	494.26
23	306.17	501.22
24	313.00	508.52
25	317.58	513.93

*** 1.819 ***

Individual data on the 32 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
1	3.5	396.3	76.7	307.9	.0	.0	.0	.0	.0
2	.3	67.0	.0	35.0	.0	.0	.0	.0	.0
3	5.9	2535.4	.0	1049.3	.0	.0	.0	.0	.0
4	9.8	8795.3	.0	2925.5	.0	.0	.0	.0	.0
5	.7	877.4	.0	271.0	.0	.0	.0	.0	.0
6	9.1	13304.2	.0	3890.3	.0	.0	.0	.0	.0
7	9.9	19091.4	.0	5096.5	.0	.0	.0	.0	.0
8	10.0	23467.9	.0	5729.0	.0	.0	.0	.0	.0
9	10.0	27263.1	.0	6057.2	.0	.0	.0	.0	.0
10	10.0	30437.9	.0	6080.2	.0	.0	.0	.0	.0
11	10.0	32962.7	.0	5798.2	.0	.0	.0	.0	.0

12	9.9	34817.7	.0	5211.7	.0	.0	.0	.0	.0
13	7.4	27121.8	.0	3365.5	.0	.0	.0	.0	.0
14	2.4	8776.8	.0	956.6	.0	.0	.0	.0	.0
15	9.7	34157.3	.0	3131.6	.0	.0	.0	.0	.0
16	2.9	9569.8	.0	662.7	.0	.0	.0	.0	.0
17	6.5	21420.0	.0	961.4	.0	.0	.0	.0	.0
18	.2	708.3	.0	18.9	.0	.0	.0	.0	.0
19	.1	430.9	.0	11.2	.0	.0	.0	.0	.0
20	3.9	12825.6	.0	165.0	.0	.0	.0	.0	.0
21	5.4	17694.8	.0	.0	.0	.0	.0	.0	.0
22	9.3	30032.7	.0	.0	.0	.0	.0	.0	.0
23	9.1	28613.9	.0	.0	.0	.0	.0	.0	.0
24	8.9	26707.2	.0	.0	.0	.0	.0	.0	.0
25	8.7	24358.5	.0	.0	.0	.0	.0	.0	.0
26	8.4	21621.3	.0	.0	.0	.0	.0	.0	.0
27	8.1	18555.1	.0	.0	.0	.0	.0	.0	.0
28	7.8	15225.3	.0	.0	.0	.0	.0	.0	.0
29	7.5	11702.6	.0	.0	.0	.0	.0	.0	.0
30	7.2	8061.8	.0	.0	.0	.0	.0	.0	.0
31	6.8	4381.0	.0	.0	.0	.0	.0	.0	.0
32	4.6	891.8	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.28	449.73
2	117.83	446.78
3	127.53	444.35
4	137.35	442.46
5	147.26	441.12
6	157.23	440.33
7	167.23	440.08
8	177.22	440.39
9	187.18	441.25
10	197.09	442.65
11	206.89	444.60
12	216.58	447.08
13	226.11	450.10
14	235.47	453.63
15	244.61	457.68
16	253.52	462.22
17	262.17	467.25
18	270.52	472.75
19	278.56	478.70
20	286.26	485.08
21	293.59	491.87
22	300.54	499.06
23	307.09	506.63
24	311.07	511.78

*** 1.846 ***

1

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.28	449.73
2	117.81	446.72
3	127.51	444.26
4	137.33	442.37
5	147.24	441.05
6	157.21	440.31
7	167.21	440.14
8	177.20	440.55
9	187.15	441.54
10	197.03	443.10
11	206.80	445.23
12	216.43	447.92
13	225.89	451.16
14	235.15	454.94
15	244.17	459.25
16	252.93	464.08
17	261.39	469.40
18	269.54	475.21
19	277.33	481.47
20	284.75	488.18
21	291.77	495.30
22	298.37	502.82
23	303.37	509.23

*** 1.847 ***

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.28	449.73
2	117.86	446.88
3	127.58	444.52
4	137.40	442.65
5	147.31	441.29
6	157.27	440.44
7	167.27	440.10
8	177.27	440.26
9	187.24	440.94
10	197.17	442.12
11	207.03	443.81
12	216.79	446.00
13	226.42	448.68
14	235.90	451.85
15	245.21	455.50
16	254.33	459.62
17	263.22	464.20
18	271.86	469.23

E6

19	280.24	474.69
20	288.33	480.57
21	296.11	486.86
22	303.55	493.53
23	310.65	500.57
24	317.38	507.97
25	323.72	515.70
26	323.98	516.05

*** 1.848 ***

1

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	103.45	448.14
2	113.16	445.77
3	122.98	443.87
4	132.88	442.43
5	142.83	441.47
6	152.82	440.97
7	162.82	440.95
8	172.81	441.41
9	182.77	442.33
10	192.67	443.73
11	202.49	445.60
12	212.22	447.92
13	221.82	450.71
14	231.28	453.95
15	240.58	457.63
16	249.69	461.75
17	258.60	466.30
18	267.28	471.26
19	275.72	476.63
20	283.89	482.39
21	291.78	488.53
22	299.37	495.04
23	306.65	501.90
24	313.59	509.10
25	317.92	514.04

*** 1.852 ***

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	103.45	448.14
2	113.20	445.91
3	123.03	444.08
4	132.93	442.65
5	142.87	441.62
6	152.85	440.99
7	162.85	440.77
8	172.85	440.96
9	182.83	441.54
10	192.78	442.54
11	202.68	443.93
12	212.52	445.73
13	222.28	447.92
14	231.94	450.50
15	241.49	453.47
16	250.91	456.83
17	260.18	460.57
18	269.30	464.67
19	278.24	469.15
20	287.00	473.98
21	295.55	479.16
22	303.89	484.69
23	311.99	490.55
24	319.85	496.73
25	327.45	503.22
26	334.79	510.02
27	341.84	517.11
28	347.36	523.12

*** 1.857 ***

1

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.28	449.73
2	117.86	446.89
3	127.59	444.57
4	137.43	442.78
5	147.35	441.53
6	157.33	440.82
7	167.32	440.65
8	177.32	441.02
9	187.28	441.94
10	197.17	443.39
11	206.97	445.38
12	216.65	447.89
13	226.17	450.93
14	235.52	454.48
15	244.67	458.54
16	253.57	463.08
17	262.22	468.10
18	270.59	473.58

E8

19	278.64	479.51
20	286.36	485.86
21	293.73	492.63
22	300.71	499.78
23	307.30	507.30
24	310.72	511.66

*** 1.866 ***

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.10	451.32
2	122.64	448.30
3	132.31	445.75
4	142.09	443.68
5	151.96	442.09
6	161.90	440.98
7	171.88	440.36
8	181.88	440.23
9	191.87	440.59
10	201.84	441.44
11	211.75	442.78
12	221.58	444.60
13	231.31	446.90
14	240.92	449.67
15	250.38	452.92
16	259.67	456.62
17	268.77	460.77
18	277.65	465.36
19	286.30	470.38
20	294.69	475.82
21	302.81	481.66
22	310.62	487.90
23	318.13	494.51
24	325.30	501.48
25	332.12	508.79
26	338.58	516.42
27	343.13	522.38

*** 1.874 ***

1

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

E9

1	108.28	449.73
2	117.88	446.94
3	127.62	444.68
4	137.47	442.94
5	147.40	441.74
6	157.37	441.07
7	167.37	440.94
8	177.36	441.35
9	187.32	442.29
10	197.21	443.78
11	207.00	445.79
12	216.68	448.32
13	226.20	451.38
14	235.54	454.94
15	244.68	459.00
16	253.59	463.55
17	262.24	468.57
18	270.60	474.04
19	278.66	479.96
20	286.39	486.31
21	293.77	493.06
22	300.77	500.20
23	307.37	507.71
24	310.41	511.56

*** 1.877 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.10	451.32
2	122.57	448.09
3	132.20	445.40
4	141.96	443.25
5	151.84	441.66
6	161.78	440.64
7	171.77	440.18
8	181.77	440.28
9	191.75	440.95
10	201.67	442.19
11	211.51	443.99
12	221.23	446.34
13	230.80	449.23
14	240.19	452.67
15	249.38	456.63
16	258.32	461.11
17	266.99	466.08
18	275.37	471.54
19	283.43	477.46
20	291.14	483.83
21	298.47	490.63
22	305.41	497.83
23	311.93	505.41

```
    24         318.01       513.35
    25         318.64       514.28

       ***     1.878    ***

1
              Y            A     X     I     S            F     T

               .00    117.26    234.52    351.78    469.04    586.30
X          .00 +---------+---------+---------+------*--+---------+
               -
               -                                    *
               -                                    *.
               -                                     *
               -                                     *
        117.26 +                                     1.
               -                                     1.
               -                                     1..
               -                                     1...
               -                                     *..*
               -                                     1..*
A       234.52 +                                     21...
               -                                     .11..
               -                                     .811..
               -                                     *W6112
               -                                     ...6411
               -                                     .....64.
X       351.78 +                                     .......*
               -                                      .......
               -                                       ......
               -                                        .....
               -                                          ...
               -                                           ..
I       469.04 +
               -
               -                                      *
               -
               -                                            *
               -
S       586.30 +
               -
               -
               -
               -
               -
        703.56 +
               -
               -
               -
               -
               -
F       820.82 +
               -
               -
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E11

-
-
-
T 938.08 +

E12

1

** PCSTABL5M **

by
Purdue University

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 3/31/95
Time of Run: 10:00AM
Run By: MJC
Input Data Filename: BARITE1.IN
Output Filename: BARITE1E.OUT

PROBLEM DESCRIPTION BARITE1.IN

BOUNDARY COORDINATES

8 Top Boundaries
15 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	435.00	40.00	435.00	2
2	40.00	435.00	50.00	438.00	2
3	50.00	438.00	80.00	447.00	3
4	80.00	447.00	100.00	447.00	3
5	100.00	447.00	200.00	480.00	1
6	200.00	480.00	215.00	480.00	1
7	215.00	480.00	345.00	523.00	1
8	345.00	523.00	545.00	533.00	1
9	101.00	447.10	200.00	449.10	4
10	200.00	449.10	300.00	451.10	4
11	300.00	451.10	500.00	461.10	4
12	100.00	447.00	200.00	449.00	3
13	200.00	449.00	300.00	451.00	2
14	300.00	451.00	500.00	461.00	2
15	50.00	438.00	200.00	449.00	2

1

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Total Saturated Cohesion Friction Pore Pressure Piez.

Type No.	Unit Wt. (pcf)	Unit Wt. (pcf)	Intercept (psf)	Angle (deg)	Pressure Param.	Constant (psf)	Surface No.
1	100.0	110.0	.0	34.0	.00	.0	1
2	105.0	115.0	.0	20.0	.00	.0	1
3	110.0	115.0	.0	35.0	.00	.0	1
4	100.0	100.0	.0	19.0	.00	.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 3 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	102.00	449.00
2	300.00	452.00
3	500.00	463.00

A Horizontal Earthquake Loading Coefficient
Of .100 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned

Cavitation Pressure = .0 psf

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

Janbus Empirical Coef. is being used for the case of c & phi both > 0
900 Trial Surfaces Have Been Generated.

30 Surfaces Initiate From Each Of 30 Points Equally Spaced
Along The Ground Surface Between X = 60.00 ft.
and X = 200.00 ft.

Each Surface Terminates Between X = 300.00 ft.
and X = 450.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =440.00 ft.

10.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	103.45	448.14
2	113.12	445.59
3	122.90	443.52
4	132.77	441.93
5	142.71	440.82
6	152.69	440.20
7	162.69	440.07
8	172.69	440.43
9	182.65	441.28
10	192.56	442.61
11	202.39	444.43
12	212.13	446.72
13	221.74	449.49
14	231.20	452.73
15	240.49	456.42
16	249.59	460.57
17	258.48	465.15
18	267.13	470.17
19	275.53	475.60
20	283.65	481.43
21	291.47	487.66
22	298.99	494.26
23	306.17	501.22
24	313.00	508.52
25	317.58	513.93

*** 1.291 ***

Individual data on the 32 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
1	3.5	396.3	76.7	307.9	.0	.0	39.6	.0	.0

E15.

2	.3	67.0	.0	35.0	.0	.0	6.7	.0	.0
3	5.9	2535.4	.0	1049.3	.0	.0	253.5	.0	.0
4	9.8	8795.3	.0	2925.5	.0	.0	879.5	.0	.0
5	.7	877.4	.0	271.0	.0	.0	87.7	.0	.0
6	9.1	13304.2	.0	3890.3	.0	.0	1330.4	.0	.0
7	9.9	19091.4	.0	5096.5	.0	.0	1909.1	.0	.0
8	10.0	23467.9	.0	5729.0	.0	.0	2346.8	.0	.0
9	10.0	27263.1	.0	6057.2	.0	.0	2726.3	.0	.0
10	10.0	30437.9	.0	6080.2	.0	.0	3043.8	.0	.0
11	10.0	32962.7	.0	5798.2	.0	.0	3296.3	.0	.0
12	9.9	34817.7	.0	5211.7	.0	.0	3481.8	.0	.0
13	7.4	27121.8	.0	3365.5	.0	.0	2712.2	.0	.0
14	2.4	8776.8	.0	956.6	.0	.0	877.7	.0	.0
15	9.7	34157.3	.0	3131.6	.0	.0	3415.7	.0	.0
16	2.9	9569.8	.0	662.7	.0	.0	957.0	.0	.0
17	6.5	21420.0	.0	961.4	.0	.0	2142.0	.0	.0
18	.2	708.3	.0	18.9	.0	.0	70.8	.0	.0
19	.1	430.9	.0	11.2	.0	.0	43.1	.0	.0
20	3.9	12825.6	.0	165.0	.0	.0	1282.6	.0	.0
21	5.4	17694.8	.0	.0	.0	.0	1769.5	.0	.0
22	9.3	30032.7	.0	.0	.0	.0	3003.3	.0	.0
23	9.1	28613.9	.0	.0	.0	.0	2861.4	.0	.0
24	8.9	26707.2	.0	.0	.0	.0	2670.7	.0	.0
25	8.7	24358.5	.0	.0	.0	.0	2435.9	.0	.0
26	8.4	21621.3	.0	.0	.0	.0	2162.1	.0	.0
27	8.1	18555.1	.0	.0	.0	.0	1855.5	.0	.0
28	7.8	15225.3	.0	.0	.0	.0	1522.5	.0	.0
29	7.5	11702.6	.0	.0	.0	.0	1170.3	.0	.0
30	7.2	8061.8	.0	.0	.0	.0	806.2	.0	.0
31	6.8	4381.0	.0	.0	.0	.0	438.1	.0	.0
32	4.6	891.8	.0	.0	.0	.0	89.2	.0	.0

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.28	449.73
2	117.81	446.72
3	127.51	444.26
4	137.33	442.37
5	147.24	441.05
6	157.21	440.31
7	167.21	440.14
8	177.20	440.55
9	187.15	441.54
10	197.03	443.10
11	206.80	445.23
12	216.43	447.92
13	225.89	451.16
14	235.15	454.94
15	244.17	459.25
16	252.93	464.08
17	261.39	469.40
18	269.54	475.21
19	277.33	481.47
20	284.75	488.18
21	291.77	495.30
22	298.37	502.82

E16

23	303.37	509.23

*** 1.309 ***

1

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.28	449.73
2	117.83	446.78
3	127.53	444.35
4	137.35	442.46
5	147.26	441.12
6	157.23	440.33
7	167.23	440.08
8	177.22	440.39
9	187.18	441.25
10	197.09	442.65
11	206.89	444.60
12	216.58	447.08
13	226.11	450.10
14	235.47	453.63
15	244.61	457.68
16	253.52	462.22
17	262.17	467.25
18	270.52	472.75
19	278.56	478.70
20	286.26	485.08
21	293.59	491.87
22	300.54	499.06
23	307.09	506.63
24	311.07	511.78

*** 1.309 ***

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.28	449.73
2	117.86	446.88
3	127.58	444.52
4	137.40	442.65
5	147.31	441.29
6	157.27	440.44
7	167.27	440.10
8	177.27	440.26

9	187.24	440.94
10	197.17	442.12
11	207.03	443.81
12	216.79	446.00
13	226.42	448.68
14	235.90	451.85
15	245.21	455.50
16	254.33	459.62
17	263.22	464.20
18	271.86	469.23
19	280.24	474.69
20	288.33	480.57
21	296.11	486.86
22	303.55	493.53
23	310.65	500.57
24	317.38	507.97
25	323.72	515.70
26	323.98	516.05

*** 1.314 ***

1

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	103.45	448.14
2	113.16	445.77
3	122.98	443.87
4	132.88	442.43
5	142.83	441.47
6	152.82	440.97
7	162.82	440.95
8	172.81	441.41
9	182.77	442.33
10	192.67	443.73
11	202.49	445.60
12	212.22	447.92
13	221.82	450.71
14	231.28	453.95
15	240.58	457.63
16	249.69	461.75
17	258.60	466.30
18	267.28	471.26
19	275.72	476.63
20	283.89	482.39
21	291.78	488.53
22	299.37	495.04
23	306.65	501.90
24	313.59	509.10
25	317.92	514.04

*** 1.317 ***

E18

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.28	449.73
2	117.86	446.89
3	127.59	444.57
4	137.43	442.78
5	147.35	441.53
6	157.33	440.82
7	167.32	440.65
8	177.32	441.02
9	187.28	441.94
10	197.17	443.39
11	206.97	445.38
12	216.65	447.89
13	226.17	450.93
14	235.52	454.48
15	244.67	458.54
16	253.57	463.08
17	262.22	468.10
18	270.59	473.58
19	278.64	479.51
20	286.36	485.86
21	293.73	492.63
22	300.71	499.78
23	307.30	507.30
24	310.72	511.66

*** 1.325 ***

1

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	103.45	448.14
2	113.20	445.91
3	123.03	444.08
4	132.93	442.65
5	142.87	441.62
6	152.85	440.99
7	162.85	440.77
8	172.85	440.96
9	182.83	441.54
10	192.78	442.54
11	202.68	443.93
12	212.52	445.73

13	222.28	447.92
14	231.94	450.50
15	241.49	453.47
16	250.91	456.83
17	260.18	460.57
18	269.30	464.67
19	278.24	469.15
20	287.00	473.98
21	295.55	479.16
22	303.89	484.69
23	311.99	490.55
24	319.85	496.73
25	327.45	503.22
26	334.79	510.02
27	341.84	517.11
28	347.36	523.12

*** 1.327 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.28	449.73
2	117.88	446.94
3	127.62	444.68
4	137.47	442.94
5	147.40	441.74
6	157.37	441.07
7	167.37	440.94
8	177.36	441.35
9	187.32	442.29
10	197.21	443.78
11	207.00	445.79
12	216.68	448.32
13	226.20	451.38
14	235.54	454.94
15	244.68	459.00
16	253.59	463.55
17	262.24	468.57
18	270.60	474.04
19	278.66	479.96
20	286.39	486.31
21	293.77	493.06
22	300.77	500.20
23	307.37	507.71
24	310.41	511.56

*** 1.334 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.10	451.32
2	122.57	448.09
3	132.20	445.40
4	141.96	443.25
5	151.84	441.66
6	161.78	440.64
7	171.77	440.18
8	181.77	440.28
9	191.75	440.95
10	201.67	442.19
11	211.51	443.99
12	221.23	446.34
13	230.80	449.23
14	240.19	452.67
15	249.38	456.63
16	258.32	461.11
17	266.99	466.08
18	275.37	471.54
19	283.43	477.46
20	291.14	483.83
21	298.47	490.63
22	305.41	497.83
23	311.93	505.41
24	318.01	513.35
25	318.64	514.28

*** 1.335 ***

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.10	451.32
2	122.64	448.30
3	132.31	445.75
4	142.09	443.68
5	151.96	442.09
6	161.90	440.98
7	171.88	440.36
8	181.88	440.23
9	191.87	440.59
10	201.84	441.44
11	211.75	442.78
12	221.58	444.60
13	231.31	446.90
14	240.92	449.67
15	250.38	452.92

16	259.67	456.62
17	268.77	460.77
18	277.65	465.36
19	286.30	470.38
20	294.69	475.82
21	302.81	481.66
22	310.62	487.90
23	318.13	494.51
24	325.30	501.48
25	332.12	508.79
26	338.58	516.42
27	343.13	522.38

*** 1.338 ***

1

```
                 Y            A     X     I     S          F     T

                .00     117.26    234.52    351.78    469.04    586.30
X      .00 +---------+---------+---------+------*--+---------+
           -
           -                                    *
           -                                    *.
           -                                     *
           -                                     *
    117.26 +                                     1.
           -                                     1.
           -                                     1..
           -                                     1...
           -                                     *..*
           -                                     1..*
A   234.52 +                                     21...
           -                                     .11..
           -                                     .011..
           -                                     *W7112
           -                                     ...7411
           -                                     .....74.
X   351.78 +                                     ........*
           -                                      .......
           -                                       ......
           -                                        .....
           -                                          ...
           -                                           ..
I   469.04 +
           -
           -                                      *
           -
           -                                            *
           -
S   586.30 +
           -
           -
           -
           -
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E22

		-
	703.56	+
		-
		-
		-
		-
		-
F	820.82	+
		-
		-
		-
		-
		-
T	938.08	+

** PCSTABL5M **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date:	3/30/95
Time of Run:	5:00PM
Run By:	MJC
Input Data Filename:	BARITE1.IN
Output Filename:	BARITE4.OUT

PROBLEM DESCRIPTION BARITE1.IN

BOUNDARY COORDINATES

8 Top Boundaries
15 Total Boundaries

	Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
BN0103	1	.00	435.00	40.00	435.00	2
	2	40.00	435.00	50.00	438.00	2
	3	50.00	438.00	80.00	447.00	3
	4	80.00	447.00	100.00	447.00	3
	5	100.00	447.00	200.00	480.00	1
	6	200.00	480.00	215.00	480.00	1
	7	215.00	480.00	345.00	523.00	1
	8	345.00	523.00	545.00	533.00	1
	9	101.00	448.00	200.00	450.00	4
	10	200.00	450.00	300.00	451.10	4
	11	300.00	451.10	500.00	462.00	4
	12	100.00	447.00	200.00	449.00	3
	13	200.00	449.00	300.00	451.00	2
	14	300.00	451.00	500.00	461.00	2
	15	50.00	438.00	200.00	449.00	2

1

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Total Saturated Cohesion Friction Pore Pressure Piez.

E24

Type No.	Unit Wt. (pcf)	Unit Wt. (pcf)	Intercept (psf)	Angle (deg)	Pressure Param.	Constant (psf)	Surface No.
1	100.0	110.0	.0	34.0	.00	.0	1
2	105.0	115.0	.0	20.0	.00	.0	1
3	110.0	115.0	.0	35.0	.00	.0	1
4	100.0	100.0	.0	19.0	.00	.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 3 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	102.00	449.00
2	300.00	452.00
3	500.00	463.00

WS0105

Janbus Empirical Coef is being used for the case of c & phi both > 0

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.

1000 Trial Surfaces Have Been Generated.

2 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 25.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	120.00	447.70	150.00	448.50	.90
2	250.00	450.50	350.00	454.00	.90

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 7 Coordinate Points

	Point No.	X-Surf (ft)	Y-Surf (ft)
FS0101	1	111.07	450.65
	2	131.48	447.97
	3	266.55	450.68
	4	284.16	468.43
	5	298.53	488.88
	6	312.85	509.37
	7	315.83	513.35

*** 1.899 ***

Individual data on the 12 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
1	10.3	2462.9	.0	.0	.0	.0	.0	.0	.0
2	5.8	3577.8	.0	156.0	.0	.0	.0	.0	.0
3	4.3	3636.9	.0	313.0	.0	.0	.0	.0	.0
4	68.5	137749.9	.0	5600.3	.0	.0	.0	.0	.0
5	15.0	45836.3	.0	1033.9	.0	.0	.0	.0	.0
6	51.5	198086.9	.0	3026.7	.0	.0	.0	.0	.0
7	.1	247.1	.0	3.7	.0	.0	.0	.0	.0
8	.8	3536.8	.0	25.9	.0	.0	.0	.0	.0
9	16.8	67375.6	.0	.0	.0	.0	.0	.0	.0
10	14.4	38230.1	.0	.0	.0	.0	.0	.0	.0
11	14.3	15575.1	.0	.0	.0	.0	.0	.0	.0
12	3.0	445.9	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	111.07	450.65
2	131.48	447.97
3	266.55	450.68
4	284.16	468.43
5	298.53	488.88
6	312.85	509.37
7	315.83	513.35

*** 1.899 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	114.53	451.80
2	123.13	447.95
3	256.68	450.61
4	271.94	470.42
5	288.39	489.24
6	305.04	507.89
7	305.06	509.79

*** 1.914 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	114.53	451.80
2	123.13	447.95
3	256.68	450.61
4	271.94	470.42
5	288.39	489.24
6	305.04	507.89
7	305.06	509.79

*** 1.914 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	119.92	453.57
2	125.83	448.06
3	250.04	450.39
4	267.46	468.32
5	284.76	486.37
6	299.16	506.81
7	299.23	507.86

*** 1.928 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	119.92	453.57
2	125.83	448.06
3	250.04	450.39
4	267.46	468.32
5	284.76	486.37
6	299.16	506.81
7	299.23	507.86

*** 1.928 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	118.33	453.05
2	126.08	447.68
3	267.89	450.76
4	282.01	471.39
5	298.19	490.45
6	314.51	509.39
7	316.39	513.54

*** 1.940 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	118.33	453.05
2	126.08	447.68
3	267.89	450.76
4	282.01	471.39
5	298.19	490.45
6	314.51	509.39
7	316.39	513.54

*** 1.940 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	122.82	454.53
2	130.25	447.62
3	260.88	450.44
4	278.03	468.63
5	291.82	489.48
6	301.30	508.54

*** 1.963 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	122.82	454.53
2	130.25	447.62
3	260.88	450.44
4	278.03	468.63
5	291.82	489.48
6	301.30	508.54

*** 1.963 ***

1

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              Y             A      X      I      S            F      T

               .00    117.26    234.52    351.78    469.04    586.30

 X        .00 +---------+---------+---------+------*--+---------+
              -
              -                                    *
              -                                    *
              -                                     *
              -                                     *
       117.26 +                                     13
              -                                     1.
              -                                      .
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E29

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           -
           -                                       *  *
           -                                          *
A  234.52  +
           -                                       3 ..
           -                                       1.3...
           -                                       *W1515
           -                                        ....11
           -                                        .......
X  351.78  +                                        ......*
           -                                         ......
           -                                           ....
           -                                              .
           -
           -
I  469.04  +
           -
           -
           -                                        *
           -
           -                                             *
S  586.30  +
           -
           -
           -
           -
           -
   703.56  +
           -
           -
           -
           -
           -
F  820.82  +
           -
           -
           -
           -
           -
T  938.08  +
```

E30

** PCSTABL5M **

by
Purdue University

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 3/31/95
Time of Run: 10:00AM
Run By: MJC
Input Data Filename: BARITE1.IN
Output Filename: BARITE4E.OUT

PROBLEM DESCRIPTION BARITE1.IN

BOUNDARY COORDINATES

8 Top Boundaries
15 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	435.00	40.00	435.00	2
2	40.00	435.00	50.00	438.00	2
3	50.00	438.00	80.00	447.00	3
4	80.00	447.00	100.00	447.00	3
5	100.00	447.00	200.00	480.00	1
6	200.00	480.00	215.00	480.00	1
7	215.00	480.00	345.00	523.00	1
8	345.00	523.00	545.00	533.00	1
9	101.00	447.10	200.00	449.10	4
10	200.00	449.10	300.00	451.10	4
11	300.00	451.10	500.00	461.10	4
12	100.00	447.00	200.00	449.00	3
13	200.00	449.00	300.00	451.00	2
14	300.00	451.00	500.00	461.00	2
15	50.00	438.00	200.00	449.00	2

1

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Total Saturated Cohesion Friction Pore Pressure Piez.

E31

Type No.	Unit Wt. (pcf)	Unit Wt. (pcf)	Intercept (psf)	Angle (deg)	Pressure Param.	Constant (psf)	Surface No.
1	100.0	110.0	.0	34.0	.00	.0	1
2	105.0	115.0	.0	20.0	.00	.0	1
3	110.0	115.0	.0	35.0	.00	.0	1
4	100.0	100.0	.0	19.0	.00	.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 3 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	102.00	449.00
2	300.00	452.00
3	500.00	463.00

A Horizontal Earthquake Loading Coefficient
Of .100 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned

Cavitation Pressure = .0 psf

Janbus Empirical Coef is being used for the case of c & phi both > 0

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.

1000 Trial Surfaces Have Been Generated.

2 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 25.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	120.00	447.70	150.00	448.50	.90

2	250.00	450.00	350.00	454.00	.90

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	118.33	453.05
2	126.08	447.68
3	267.89	450.35
4	282.01	470.98
5	298.19	490.04
6	314.51	508.98
7	316.61	513.61

*** 1.539 ***

Individual data on the 14 slices

			Water Force	Water Force	Tie Force	Tie Force	Earthquake Force		Surcharge
Slice No.	Width Ft(m)	Weight Lbs(kg)	Top Lbs(kg)	Bot Lbs(kg)	Norm Lbs(kg)	Tan Lbs(kg)	Hor Lbs(kg)	Ver Lbs(kg)	Load Lbs(kg)
1	5.4	1476.7	.0	.0	.0	.0	147.7	.0	.0
2	2.4	1618.7	.0	152.2	.0	.0	161.9	.0	.0
3	54.7	90735.9	.0	5401.6	.0	.0	9073.6	.0	.0
4	19.2	53996.8	.0	1736.0	.0	.0	5399.7	.0	.0
5	15.0	46379.5	.0	1294.9	.0	.0	4638.0	.0	.0
6	48.7	186976.1	.0	3849.6	.0	.0	18697.6	.0	.0
7	4.2	19349.6	.0	302.7	.0	.0	1935.0	.0	.0
8	.0	15.9	.0	.4	.0	.0	1.6	.0	.0
9	.1	327.7	.0	8.5	.0	.0	32.8	.0	.0
10	.7	3410.2	.0	42.5	.0	.0	341.0	.0	.0
11	13.3	51569.3	.0	.0	.0	.0	5156.9	.0	.0
12	16.2	39359.9	.0	.0	.0	.0	3936.0	.0	.0
13	16.3	17474.9	.0	.0	.0	.0	1747.5	.0	.0
14	2.1	412.6	.0	.0	.0	.0	41.3	.0	.0

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	118.33	453.05
2	126.08	447.68
3	267.89	450.35
4	282.01	470.98
5	298.19	490.04
6	314.51	508.98
7	316.61	513.61

*** 1.539 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	116.95	452.59
2	122.58	447.47
3	261.30	450.23
4	278.87	468.01
5	280.72	492.94
6	284.21	502.89

*** 1.606 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	116.95	452.59
2	122.58	447.47
3	261.30	450.23
4	278.87	468.01
5	280.72	492.94
6	284.21	502.89

*** 1.606 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

E34

1	108.68	449.86
2	124.18	447.53
3	263.89	450.15
4	281.13	468.25
5	298.53	486.20
6	300.99	508.44

*** 1.630 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.68	449.86
2	124.18	447.53
3	263.89	450.15
4	281.13	468.25
5	298.53	486.20
6	300.99	508.44

*** 1.630 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	122.68	454.48
2	142.70	447.89
3	256.29	449.97
4	270.97	470.21
5	287.92	488.58
6	304.48	507.32
7	306.35	510.22

*** 1.646 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	122.68	454.48

2	142.70	447.89
3	256.29	449.97
4	270.97	470.21
5	287.92	488.58
6	304.48	507.32
7	306.35	510.22

*** 1.646 ***

1

Failure Surface Specified By 6 Coordinate Points

Point X-Surf Y-Surf

```
                               1.1.3.
             -                                      *W.513
             -                                       ....11
             -                                       .......
X     351.78 +                                       ......*
             -                                        ......
             -                                          ....
             -                                             .
             -
             -
I     469.04 +
             -
             -                                       *
             -
             -                                             *
             -
S     586.30 +
             -
             -
             -
             -
             -
      703.56 +
             -
             -
             -
             -
             -
F     820.82 +
             -
             -
             -
             -
             -
T     938.08 +
```

E36

APPENDIX F
HYDROGEOLOGIC EVALUATION OF HEAP LEACH PAD FACILITY

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**              HELP MODEL VERSION 3.01   (14 OCTOBER 1994)                 **
**                 DEVELOPED BY ENVIRONMENTAL LABORATORY                    **
**                   USAE WATERWAYS EXPERIMENT STATION                      **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:     C:\HELP3\BARITE2.D4
TEMPERATURE DATA FILE:       C:\HELP3\BARITE2.D7
SOLAR RADIATION DATA FILE:   C:\HELP3\BARITE2.D13
EVAPOTRANSPIRATION DATA:     C:\HELP3\BARITE2.D11
SOIL AND DESIGN DATA FILE:   C:\HELP3\BARITE1A.D10
OUTPUT DATA FILE:            C:\HELP3\BARITE1A.OUT


TIME:  17:38     DATE:   3/22/1995


******************************************************************************

     TITLE:  BARITE HILL -  "FLAT" AREA - 70 FEET OF ORE - CLAY K=5x10^-6

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.


                                     LAYER  1
                                     --------

                       TYPE 1 - VERTICAL PERCOLATION LAYER
                           MATERIAL TEXTURE NUMBER   0
          THICKNESS                    =       12.00   INCHES
          POROSITY                     =        0.3980 VOL/VOL
          FIELD CAPACITY               =        0.2440 VOL/VOL
          WILTING POINT                =        0.1360 VOL/VOL
          INITIAL SOIL WATER CONTENT   =        0.2937 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =   0.999999975000E-04 CM/SEC


                                     LAYER  2     F2
```

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	36.00 INCHES
POROSITY	=	0.4370 VOL/VOL
FIELD CAPACITY	=	0.3730 VOL/VOL
WILTING POINT	=	0.2660 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4332 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.499999987000E-05 CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	822.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1310 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2845 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.999999975000E-04 CM/SEC

LAYER 4

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	18.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1310 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4570 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.999999975000E-04 CM/SEC
SLOPE	=	1.00 PERCENT
DRAINAGE LENGTH	=	50.0 FEET

LAYER 5

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 37

THICKNESS	=	0.05 INCHES
POROSITY	=	0.0000 VOL/VOL
FIELD CAPACITY	=	0.0000 VOL/VOL
WILTING POINT	=	0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999999000E-10 CM/SEC
FML PINHOLE DENSITY	=	1.00 HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00 HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD

LAYER 6

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4520 VOL/VOL
FIELD CAPACITY	=	0.4110 VOL/VOL
WILTING POINT	=	0.3110 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4520 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.999999997000E-06 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #10 WITH A GOOD STAND OF GRASS, A SURFACE SLOPE OF 4.% AND A SLOPE LENGTH OF 310. FEET.

SCS RUNOFF CURVE NUMBER	=	80.60	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	31.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	11.755	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	13.079	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	6.686	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	272.053	INCHES
TOTAL INITIAL WATER	=	272.053	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM AUGUSTA GEORGIA

MAXIMUM LEAF AREA INDEX	=	3.50
START OF GROWING SEASON (JULIAN DATE)	=	68
END OF GROWING SEASON (JULIAN DATE)	=	323
AVERAGE ANNUAL WIND SPEED	=	6.50 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	68.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	70.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	77.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	73.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR AUGUSTA GEORGIA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.88	4.21	5.07	4.11	3.99	4.00
4.73	3.93	3.80	2.60	2.54	3.64

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR AUGUSTA GEORGIA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
42.60	46.20	53.40	62.40	70.20	76.60
80.00	79.10	73.70	62.80	53.80	45.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR AUGUSTA GEORGIA

STATION LATITUDE = 33.22 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	5.09	3.51	5.73	3.26	3.57	3.70
	5.95	3.46	4.75	2.44	2.11	3.26
STD. DEVIATIONS	2.88	1.67	3.32	1.97	2.24	2.15
	3.08	2.03	2.66	1.76	1.59	1.53
RUNOFF						
TOTALS	0.999	0.212	1.039	0.192	0.097	0.096
	0.376	0.070	0.366	0.069	0.069	0.093
STD. DEVIATIONS	1.222	0.446	1.646	0.597	0.257	0.306
	0.456	0.140	0.639	0.140	0.254	0.267
EVAPOTRANSPIRATION						
TOTALS	1.286	1.806	2.979	3.835	4.177	3.656

	4.754	3.438	2.432	2.766	1.623	0.913
STD. DEVIATIONS	0.234	0.235	0.444	0.851	1.625	1.445
	1.555	1.510	0.578	0.776	0.598	0.256

LATERAL DRAINAGE COLLECTED FROM LAYER 4

TOTALS	0.7267	0.4051	0.3769	0.4296	0.6543	0.7615
	1.0965	1.0820	1.0227	0.9550	0.8530	0.9022
STD. DEVIATIONS	0.3177	0.1920	0.1471	0.2642	0.3863	0.4174
	0.3417	0.2173	0.3963	0.3258	0.3584	0.2486

PERCOLATION/LEAKAGE THROUGH LAYER 6

TOTALS	0.0201	0.0167	0.0180	0.0177	0.0194	0.0195
	0.0218	0.0217	0.0209	0.0212	0.0201	0.0210
STD. DEVIATIONS	0.0020	0.0012	0.0008	0.0015	0.0020	0.0021
	0.0016	0.0010	0.0019	0.0016	0.0018	0.0012

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ACROSS LAYER 6

AVERAGES	31.6108	29.5615	28.9478	29.2581	30.8199	31.9221
	34.1987	34.1745	34.0289	33.3871	32.8992	33.1124
STD. DEVIATIONS	2.7517	1.8718	1.1712	2.1349	2.8711	3.0155
	2.2186	1.4083	2.6638	2.2025	2.5484	1.6876

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.85 (8.064)	170060.0	100.00
RUNOFF	3.679 (2.5892)	13353.38	7.852
EVAPOTRANSPIRATION	33.664 (3.9011)	122201.52	71.858
LATERAL DRAINAGE COLLECTED FROM LAYER 4	9.26534 (1.75931)	33633.199	19.77725
PERCOLATION/LEAKAGE THROUGH FROM LAYER 6	0.23807 (0.00815)	864.197	0.50817
AVERAGE HEAD ACROSS TOP OF LAYER 6	31.993 (0.955)		

F6

CHANGE IN WATER STORAGE	0.002	(4.9366)	7.78	0.005

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	4.71	17097.301
RUNOFF	2.606	9460.6445
DRAINAGE COLLECTED FROM LAYER 4	0.50002	1815.05933
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.002824	10.25131
AVERAGE HEAD ACROSS LAYER 6	124.014	
SNOW WATER	2.63	9548.0449

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4202
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.2083

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	3.5249	0.2937
2	15.5939	0.4332
3	233.9026	0.2846
4	8.2260	0.4570
5	0.0000	0.0000
6	10.8480	0.4520
SNOW WATER	0.000	

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**               HELP MODEL VERSION 3.01   (14 OCTOBER 1994)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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******************************************************************************


PRECIPITATION DATA FILE:     C:\HELP3\BARITE2.D4
TEMPERATURE DATA FILE:       C:\HELP3\BARITE2.D7
SOLAR RADIATION DATA FILE:   C:\HELP3\BARITE2.D13
EVAPOTRANSPIRATION DATA:     C:\HELP3\BARITE2.D11
SOIL AND DESIGN DATA FILE:   C:\HELP3\BARITE2A.D10
OUTPUT DATA FILE:            C:\HELP3\BARITE2A.OUT


TIME:  17:44       DATE:   3/22/1995


******************************************************************************

     TITLE:  BARITE HILL - "SLOPE" AREA - 35 FEET OF ORE - CLAY K=5x10^-6

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.


                                  LAYER  1
                                  --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER   0
           THICKNESS                     =      12.00    INCHES
           POROSITY                      =       0.3980 VOL/VOL
           FIELD CAPACITY                =       0.2440 VOL/VOL
           WILTING POINT                 =       0.1360 VOL/VOL
           INITIAL SOIL WATER CONTENT    =       0.2904 VOL/VOL
           EFFECTIVE SAT. HYD. COND.     =  0.999999975000E-04 CM/SEC


                                  LAYER  2         F10
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TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	36.00 INCHES
POROSITY	=	0.4370 VOL/VOL
FIELD CAPACITY	=	0.3730 VOL/VOL
WILTING POINT	=	0.2660 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4329 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.499999987000E-05 CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	402.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1310 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2923 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.999999975000E-04 CM/SEC

LAYER 4

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	18.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1310 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4570 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.999999975000E-04 CM/SEC
SLOPE	=	1.00 PERCENT
DRAINAGE LENGTH	=	50.0 FEET

LAYER 5

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 37

THICKNESS	=	0.05 INCHES
POROSITY	=	0.0000 VOL/VOL
FIELD CAPACITY	=	0.0000 VOL/VOL
WILTING POINT	=	0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999999000E-10 CM/SEC
FML PINHOLE DENSITY	=	1.00 HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00 HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD

LAYER 6

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	24.00	INCHES
POROSITY	=	0.4520	VOL/VOL
FIELD CAPACITY	=	0.4110	VOL/VOL
WILTING POINT	=	0.3110	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4520	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.999999997000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #10 WITH A GOOD STAND OF GRASS, A SURFACE SLOPE OF 33.% AND A SLOPE LENGTH OF 105. FEET.

SCS RUNOFF CURVE NUMBER	=	82.80	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	31.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	11.710	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	13.079	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	6.686	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	155.648	INCHES
TOTAL INITIAL WATER	=	155.648	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM AUGUSTA GEORGIA

MAXIMUM LEAF AREA INDEX	=	3.50	
START OF GROWING SEASON (JULIAN DATE)	=	68	
END OF GROWING SEASON (JULIAN DATE)	=	323	
AVERAGE ANNUAL WIND SPEED	=	6.50	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	68.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	70.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	77.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	73.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR AUGUSTA GEORGIA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.88	4.21	5.07	4.11	3.99	4.00
4.73	3.93	3.80	2.60	2.54	3.64

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR AUGUSTA GEORGIA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
42.60	46.20	53.40	62.40	70.20	76.60
80.00	79.10	73.70	62.80	53.80	45.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR AUGUSTA GEORGIA

STATION LATITUDE = 33.22 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	5.09	3.51	5.73	3.26	3.57	3.70
	5.95	3.46	4.75	2.44	2.11	3.26
STD. DEVIATIONS	2.88	1.67	3.32	1.97	2.24	2.15
	3.08	2.03	2.66	1.76	1.59	1.53
RUNOFF						
TOTALS	1.066	0.247	1.117	0.213	0.124	0.110
	0.475	0.099	0.417	0.097	0.079	0.119
STD. DEVIATIONS	1.248	0.437	1.659	0.557	0.275	0.310
	0.529	0.175	0.644	0.179	0.264	0.281
EVAPOTRANSPIRATION						
TOTALS	1.281	1.802	2.978	3.837	4.159	3.641

	4.732	3.407	2.443	2.739	1.623	0.909
STD. DEVIATIONS	0.234	0.238	0.445	0.851	1.636	1.422
	1.566	1.508	0.560	0.785	0.596	0.257

LATERAL DRAINAGE COLLECTED FROM LAYER 4

TOTALS	0.6413	0.3921	0.4399	0.4282	0.7167	0.8660
	1.0515	1.0800	0.9480	0.8765	0.6950	0.7462
STD. DEVIATIONS	0.2392	0.1308	0.3383	0.2699	0.4468	0.4189
	0.3762	0.2638	0.2243	0.2674	0.2489	0.1812

PERCOLATION/LEAKAGE THROUGH LAYER 6

TOTALS	0.0209	0.0171	0.0188	0.0182	0.0211	0.0218
	0.0239	0.0243	0.0228	0.0227	0.0208	0.0217
STD. DEVIATIONS	0.0024	0.0012	0.0027	0.0022	0.0036	0.0034
	0.0030	0.0020	0.0018	0.0022	0.0021	0.0015

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ACROSS LAYER 6

AVERAGES	33.0204	30.3513	30.1518	30.0938	33.5276	35.7934
	37.8816	38.4350	37.3424	36.1256	34.2206	34.6174
STD. DEVIATIONS	3.4127	2.0156	3.9977	3.3745	5.4045	5.2582
	4.4965	3.0210	2.7091	3.3040	3.2801	2.2354

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES		CU. FEET	PERCENT
PRECIPITATION	46.85	(8.064)	170060.0	100.00
RUNOFF	4.162	(2.6641)	15109.19	8.885
EVAPOTRANSPIRATION	33.551	(3.8719)	121788.53	71.615
LATERAL DRAINAGE COLLECTED FROM LAYER 4	8.88147	(2.01198)	32239.729	18.95785
PERCOLATION/LEAKAGE THROUGH FROM LAYER 6	0.25404	(0.01549)	922.168	0.54226
AVERAGE HEAD ACROSS TOP OF LAYER 6	34.297	(1.950)		

CHANGE IN WATER STORAGE	0.000	(4.6001)	0.43	0.000

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	4.71	17097.301
RUNOFF	2.481	9006.3867
DRAINAGE COLLECTED FROM LAYER 4	0.14996	544.36292
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.001617	5.86944
AVERAGE HEAD ACROSS LAYER 6	76.669	
SNOW WATER	2.63	9548.0449
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4202	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.2080	

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	3.4847	0.2904
2	15.5843	0.4329
3	117.5070	0.2923
4	8.2260	0.4570
5	0.0000	0.0000
6	10.8480	0.4520
SNOW WATER	0.000	

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APPENDIX G
LABORATORY TEST RESULTS

CONSTANT HEAD PERMEABILITY TEST
FIXED WALL - ASTM D 2434

Project:	Barite Hill	Project No:	14115
Sample No:	Spent Ore	Tested By:	MC
Sample Type:	Remolded	Date:	3/39/95

INITIAL SAMPLE DATA

Sample Area - A (cm^2)	81.07	Max. Dry Density (pcf)	141.70
Sample Ht. - L (cm)	9.65	Opt. Moisure Content	8.9%
Volume (cm^3)	782.3	Init. Dry Density (pcf)	128.80
Dry Weight (g)	1614.0	Percent Max. Dry Density	90.9%
Moisture Content	10.0%		

FINAL SAMPLE DATA

Change Ht. (cm)	0	Final Volume (cm^3)	782.3
Sample Ht. (cm)	9.65	Final Dry Density (pcf)	128.8
Wet Wt. (g)	2086.00		
Moisture Content %	13.30		

TEST DATA

Head (h) = 33.5 cm

Elapsed Time t (min)	Vol. Effluent Q (cm^3)	Permeability k (cm/sec)
1525.00	30.0	1.2E-06
2933.00	62.1	1.3E-06
1336.00	28.5	1.3E-06

k = QL/Aht

Elapsed Time t (min)	Vol. Effluent Q (cm^3)	Permeability k (cm/sec)
1560.00	31.1	1.2E-06
1301.00	25.3	1.2E-06

Ave. Permeability= 1.2E-06

APPENDIX H
GROUNDWATER MONITORING AND DETECTION PLAN
AND
SAMPLING AND ANALYSIS PLAN

NEVADA GOLDFIELDS INC.
BARITE HILL PROJECT

GROUND WATER MONITORING PLAN

SOLID WASTE DUMP
PERMIT IWP-242

H2

NEVADA GOLDFIELDS
GROUND WATER MONITORING PLAN
SOLID WASTE DUMP
PERMIT IWP - 242

In accordance with solid waste permit IWP - 242, the following ground water monitoring plan is submitted for our residue disposal facility.

GROUND WATER MONITORING SYSTEM

Seven clusters of monitoring wells have been installed for the facility. Each cluster consists of one shallow well to monitor saprolite water table as requested in permit condition 7, and also wells to monitor any deeper fracture zones that are hydraulically active. These well locations are shown on the enclosed drawing (IWF-1). A schematic drawing of both the shallow and deep wells is also enclosed. The well depths are as follows:

WELL NUMBER	DEPTH	WELL NUMBER	DEPTH
A1	193 FT	B1	171 FT
A2	143 FT	B2	121 FT
A3	70 FT		
C1	182 FT	D1	130 FT
C2	75 FT	D2	160 FT
GW-5	37.8 FT	D3	79 FT
E1	60 FT	F1	205 FT
E2	300 FT	F2	140 FT
E3	106 FT	F3	75 FT
GW-6	28.4 FT		
G1	38 FT		
G2	200 FT		
G3	125 FT		

Two systems (clusters A and F) have been installed hydraulically upgradient from the facility for groundwater samples that are representative of background groundwater quality and are not affected by the facility.

Five systems (clusters B, C, D, E, and G) have been installed hydraulically downgradient from the facility to detect any statistically significant degradation of groundwater quality if degradation of groundwater were to occur. In addition, four more wells have been installed hydraulically downgradient from the waste facility toe, one on either side of Well cluster D and two around the edges of the Barren Pond, as shown on the enclosed drawing. These four wells (L, M, O, and P) will monitor water quality in the uppermost aquifer.

The monitoring system will be maintained so that water quality immediately upgradient and downgradient of the facility may be measured.

All monitoring wells have been or will be constructed and integrity will be maintained in accordance with R.61-71.

If it is determined by Nevada Goldfields or SCDHEC that the groundwater monitoring system no longer satisfies the minimum requirements for the number, location, construction, or integrity of the wells with relation to structurally damaged wells, dry wells, wells no longer upgradient or downgradient, etc., Nevada Goldfields will:

1. Notify SCDHEC Solid and Hazardous waste Div. in writing within seven days of evaluation data, but no later than sixty days after collecting water level data, that the monitoring system no longer satisfies permit conditions;

2. Submit to SCDHEC Solid and Hazardous Waste Div. in writing a complete proposal to upgrade the monitoring well network within thirty days of notification from DHEC, but no later than ninety days after collecting water level data; and

3. Complete installation of additional well(s) necessary to achieve compliance with permit conditions within forty-five days of receiving approval from DHEC.

ROUTINE GROUNDWATER MONITORING

Nevada Goldfields will perform routine monitoring of groundwater quality and elevation conditions to determine if residue disposal activities are affecting groundwater quality at the facility.

Groundwater monitoring will be performed according to the constituent list and schedule in table 1 for all wells specified in the permit condition 7d and any other well(s) deemed necessary by the facility or SCDHEC. A copy of the sampling and analysis plan used by Nevada Goldfields is enclosed.

Initially, only the wells to the upper aquifer will be sampled. These wells will be sampled twice within one week and then quarterly during the first year of operation for background data. They will continue to be sampled quarterly throughout the life of the project and after closure. If, at any time, it appears that the upper aquifer is becoming contaminated by metals or cyanide leaching from the residues, then the monitor wells to the second aquifer will be sampled twice in one week to start establishing background data for this aquifer.

Nevada Goldfields will determine on a quarterly basis the elevation of the groundwater surface in each sampled well the same day the samples are collected.

Each quarter, Nevada Goldfields will collect, preserve and analyze groundwater samples as outlined in the enclosed Sampling and Analysis Plan, for the constituents listed in table 1. The following procedures will alos be used:

> Samples will be collected by bailing using E.P.A. protocols. Three well volumes will be evacuated prior to collection of the sample, or the well will be evacuated until dry. Well volumes will be determined by measuring the depth to water - depth to bottom of well * radius of the well squared * pi.
>
> Samples will be preserved according to E.P.A. protocols. These protocols are outlined in the Appendix to the attached Sampling and Analysis Plan.
>
> Samples will be sent to a SCDHEC certified lab for analysis on all constituents listed in table 1.

DATA EVALUATION

It is well known that the metals and other constituents of groundwater vary greatly throughout the course of the year. Rainfall events and changes in the height of the water table can naturally cause wide fluctuations in the measured parameters. This needs to be taken into account when evaluating groundwater data.

Another factor that needs to be taken into account is the general mineralization of the area. Nevada Goldfields, Inc. would not be mining here if significant mineralization had not occurred in this area. This means that many metal values may naturally be outside of "normal" groundwater parameters. No amount of remediation will change "natural" metal levels to "normal" ones.

Nevada Goldfields will establish baseline water quality data for all wells for the constituents included in the first six sampling events as specified in table 1. The six sampling events will include two events prior to waste disposal to be collected at a time interval not less than one week apart, and four quarterly sampling events during the first year of operation.

Nevada Goldfields will compare the downgradient water quality to the upgradient water quality using one or more of the procedures specified in the Federal Register, 40 CFR Parts 257 and 258.

The initial six samples of each downgradient well and the results of the two upgradient wells (18 samples total) will be used as the sample population to establish a tolerance interval for each constituent using the distribution of the background data.

A tolerance interval represents the limits within which a specified percentage of the population is expected to lie with a given probability. If the standard deviation of the population of samples were known, the limits for a given percentage of the population could be calculated with certainty. However, when only an estimate of the standard deviation is known, based on a limited sampling population, a tolerance interval based on inclusion of a percentage of the population with a specific probability of inclusion is all that can be calculated.[1]

The tolerance interval will be calculated as follows:

$$\text{Tolerance Interval} = X +/- ks$$

where X is the sampled population mean, s is the estimated standard deviation, and k is a factor based on the percentage, p, of population to be included, the probability, t, of inclusion, and the number of measurements used to calculate X and s. The percentage and probability will both be used at the 95% level, corresponding with the .05 Type I error level suggested in the EPA subtitle D regulations. The k value will be taken from a chart such as that found in NBS Handbook 91.[2] For the purpose of determining X and s, all data reading below the detection limit will be used as the detection limit value.

After the tolerance interval has been established, any sample that reads outside of the interval will be suspected of showing groundwater contamination for the element in question.

There will be some parameters that can not be analyzed by the above method. Any samples that constantly read below the detection limit will have no measurable standard deviation, and therefore no tolerance level. An increase in the reported values of these samples over three sampling events will be considered to show possible contamination.

If groundwater contamination is suspected, the well will be resampled and reanalyzed for the suspicious parameters. If

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[1] Taylor, John; Quality Assurance of Chemical Measurements, Lewis Publishers, c1987, pg31.

[2] Natrella, M.G., "Experimental Statistics", NBS Handbook 91, National Bureau of Standards, Gaithersburg, MD 20899.

the second sampling also shows values outside the allowable range, the Department will be notified. If the average of the two values is greater than groundwater limits for the parameter, an assessment of groundwater impact will begin as addressed in Permit IWP-242, Condition 10. If the average of the two values is less than groundwater limits, no action will be taken until after sampling is completed for the following quarter.

The following quarter the monitor well in question would be sampled along with the rest of the wells. If the value of the suspicious parameter shows an increase when compared with the average value obtained from the two samples taken the previous quarter, the well will be resampled and retested for that parameter. If the average of these two values is higher than the average from the previous quarter, assessment of groundwater impact will begin. If the value of the suspicious parameter has decreased when compared with the average value obtained from the two samples taken the past quarter, we will wait and see what the following quarter's results are for that parameter.

This quarterly tracking will continue until the parameter has dropped back to within the allowable range (at which time the incident is assumed to be over), the average value of the two samples taken within the same quarter has increased for two consecutive quarters, or the value has increased above groundwater limits.

The quarterly samples from the upgradient wells will be compared with the baseline established from these wells (12 samples) in the same manner. This will help to determine if the groundwater is deteriorating above the minesite. If these wells show groundwater deterioration, the Department will be notified so that it may look for the cause if it deems it is warranted.

If any more wells are added to the system due to changing hydrology, etc., the same plan will be used.

Nevada Goldfields will ensure that the groundwater flow rate and direction are evaluated by a qualified registered professional geologist or geotechnical engineer each time samples are taken. A potentiometric surface map will be generated which will demonstrate the flow directions for the uppermost aquifer.

CLOSURE/POST CLOSURE MONITORING

Nevada Goldfields will monitor groundwater quality in the upgradient and downgradient wells in the uppermost aquifer at the facility for a period of thirty years as required in permit condition 12. After five years of post closure monitoring, NGI will petition DHEC to terminate or modify post closure monitoring if study of the site hydrology and groundwater quality shows justification.

The monitoring program will be identical to the operations monitoring plan described in detail above. The cost of the groundwater monitoring program is projected at $30,000 per year (in constant 1991 dollars).

REPORTING

Nevada Goldfields will submit results of the groundwater monitoring program as specified in table 1 in accordance with the following schedule stipulated in permit condition 13:

Sampling Quarter	Sampling Period	Results to DHEC
1st	January-February	April 15
2nd	April-May	July 15
3rd	July-August	October 15
4th	October-November	January 15

Nevada Goldfields will submit a quarterly report containing all water quality data and statistical analyses to DHEC as specified in the schedule above. An annual report will be submitted with the fourth quarter report summarizing the quarterly determinations of groundwater flow direction and rate. This report will include determination as to whether the monitoring well network continues to meet the requirements of permit condition 7.

GROUND WATER MONITORING WELLS
SAMPLING AND ANALYSIS PLAN

H9

INTRODUCTION

Monitoring of the ground water is an important part of the overall plan to protect the environment at the Barite Hill Project. Ground water monitor wells have been strategically placed so that any leaks in the solid waste facility, the pads, or ponds can be detected and the problem addressed before irreparable damage is done to the environment. Two well clusters, A and F, have been installed upgradient of the system. These wells will be used to determine the background quality of the ground water. The rest of the wells are hydraulically downgradient.

This sampling plan must be followed to ensure that the ground water samples taken are truly representative of the ground water, that no contamination is introduced into the ground water by the sampling procedures, and that the analytical results are accurate.

EQUIPMENT/SITE PREPARATION

1. All wells are to be kept locked unless sampling is taking place.

2. Equipment used for monitor well sampling is dedicated for this purpose only and is stored in such a way as to keep it clean and free of contamination.

3. All equipment that will go down the well (M-scope, teflon bailer) are triple rinsed with distilled water and allowed to dry before entering each well.

CALCULATION OF AMOUNT OF WATER TO BE EVACUATED PRIOR TO SAMPLING

4. Depth to water is to be measured from the top of the PVC casing using the M-scope. Depth to water is measured in all wells that are to be sampled before sampling any of the wells. Depth to water is recorded on Water Sampling Form (See Appendix).

5. Subtract the depth to water from the total depth of the well to calculate the length of the water column.

6. Use the following formula to find the total volume of water in the well:

   Volume = $(0.5 * \text{casing diameter})^2 * \text{pi} * \text{water column depth}$

7. Multiply the volume obtained in step six above by 3 to get the amount of water that must be evacuated before sampling.

PUMPING WELLS AND SAMPLE COLLECTION

8. Sample upgradient wells first to ensure they are not contaminated by anything in the downgradient wells.

FOR 4" diameter wells with dedicated air-lift pumps (GW 1,2,3,5&6)

9. Pump the well with the dedicated air lift pump into a graduated bucket until the three well volumes calculated in step seven are evacuated or until the well is pumped dry.

10. Allow the well to recover enough volume to fill the required sample bottles, then sample while wearing latex gloves. The required parameters to sample for are listed in the Appendix.

FOR 2" Monitor Wells (no pumps, Wells A-O)

11. Lay plastic on the ground around the well to prevent contamination of the sampling equipment. Wear latex gloves to prevent contaminating the bailer with your hands. Evacuate three well volumes (calculated in step 7) or until dry, using the teflon bailer and disposable bailing line. Disposable bailing line should be composed of a chemically inert material such as polypropylene rope or nylon weedeater line. (Be sure to replace bailing line before bailing each well.)

12. Fill the required sample bottles using the teflon bailer. The required parameters are listed in the Appendix.

QUALITY CONTROL SAMPLES

13. Each sampling event should include double sampling one well for all parameters. These samples will be sent in to the lab for analysis under the designation Well T. Randomly pick which well is to be sampled by drawing from a hat. Record which well is picked on the Water Sampling Form. Sample as above. Blank samples consisting of distilled water will also be sent to the laboratory under the designation Well U.

INTERIM SAMPLE STORAGE

14. Immediately after collecting each sample, add any preservatives necessary, (see Table 1), cap and store in cooler. Sample bottles usually already contain the preservatives necessary when sent from the lab, however, you should check the label to make sure no mistakes were made and the preservative in the bottle is the correct one.

FIELD MEASUREMENTS

15. pH, Specific Conductivity, and Temperature measurements must be taken in the field.

pH - Calibrate meter using the two standard method. First, place the electrode in pH 7.00 buffer solution and set meter to 7.00 using the calibration knob. Rinse the electrode by swirling in distilled water and then place in the pH 4.00 buffer solution. Adjust the slope so the meter reads 4.00. Field calibration should be done in the field so the temperature at calibration is as close as possible to the temperature at reading. (The meter has built-in temperature compensation, but will still fluctuate slightly with temperature.) Again rinse electrode with distilled water. Repeat the above steps until stable readings are obtained. The meter is now ready to operate. Read ground water field pH by placing electrode into a sample. The pH recorded will be the average of three separate readings taken at each well. Check for meter drift by reading the pH of the pH 4.00 buffer at least every fourth well. Recalibrate meter if needed.

Specific Conductivity - Specific conductivity is also read in the field using a meter. The probe calibration is checked by reading a standard solution of a known conductivity. If this reading is not correct, follow the manufacturer's instructions to recalibrate the probe. Again, the specific conductance recorded will be an average of three separate conductivity readings for each well.

Temperature - Temperature is read of a thermometer allowed to equilibrate in a ground water sample.

CHAIN OF CUSTODY

16. A Chain of Custody must be kept with all monitor well samples to ensure that the sample taken from the well is the same sample that reaches the lab for analysis The sampler should fill out a Chain of Custody form for all samples. An example of a Chain of Custody form can be found in the Appendix. A copy of the completed Chain of Custody forms and copies of the completed water sampling forms should be turned into Jean Whisnant.

SHIPMENT

17. Samples will be preserved at 4 degrees C immediately after collection (See Interim Storage Section above). They will

APPENDIX

#13

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL
SOLID WASTE LANDFILL GROUNDWATER DETECTION MONITORING REQUIREMENTS
(12/89)

Constituent	*2 Samples Prior To Waste Disposal	*1st Year Quarterly	Second Year and All Remaining Years 1st, 2nd & 3rd Qtr	4th Qtr
Ammonia	X	X		X
Bicarbonate	X	X		X
Calcium	X	X		X
Chloride	X	X	X	X
Fluoride	X	X		X
Iron	X	X	X	X
Magnesium	X	X		X
Manganese	X	X		X
Nitrate (as N)	X	X	X	X
Potassium	X	X		X
Sodium	X	X		X
Sulfate	X	X	X	X
TOC	X	X	X	X
Total Dissolved Solids	X	X	X	X
Temperature	X	X	X	X
Specific Cond.	X	X	X	X
pH (Field & Lab)	X	X	X	X
Aluminum	X	X	X	X
Arsenic	X	X	X	X
Barium	X	X	X	X
Cadmium	X	X	X	X
Chromium	X	X	X	X
Copper	X	X	X	X
Lead	X	X	X	X
Nickel	X	X	X	X
Mercury	X	X	X	X
Selenium	X	X	X	X
Silver	X	X	X	X
Zinc	X	X	X	X
Cyanide	X	X	X	X
Water Level Elev. All Wells (Feet MSL)	X	X	X	X

* Applies only to New or Expanding Facilities

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U.S. EPA RECOMMENDED PRESERVATION METHODS FOR WATER AND WASTEWATER SAMPLES[a]

Test	Preservation Method	Max. Recommended Holding Time
Acidity Alkalinity	Store at 4°C	14 days
Ammonia	Add H_2SO_4 to pH <2 Store at 4°C	24 hours
BOD	Store at 4°C	48 hours
COD	Add H_2SO_4 to pH <2	28 days
Chloride	None required	28 days
Chlorine, residual	Det. on site	No holding
Cyanide	Add NaOH to pH >12 Store at 4°C	14 days
Dissolved Oxygen	Det. on site	No holding
Fluoride	None required	28 days
Mercury	Add HNO_3 to pH <2	28 days (in glass) 13 days (in plastic)
Metals	Add HNO_3 to pH <2	6 months
Nitrate	Add H_2SO_4 to pH <2 Store at 4°C	48 hours
Nitrite	Store at 4°C	48 hours
Oil & Grease	Add H_2SO_4 to pH <2	28 days
Organic Carbon	Add H_2SO_4 to pH <2 Store at 4°C	28 days
pH	Store at 4°C	No holding
Phenolics	Add H_3PO_4 to pH <4 & 1.0 g $CuSO_4$/L Store at 4°C	28 days
Phosphorus, ortho	Filter on site	48 hours
Phosphorus, total	Add H_2SO_4 to pH <2 Store at 4°C	28 days
Solids	Store at 4°C	7 days
Specific Conductivity	Store at 4°C	28 days
Sulfate	Store at 4°C	28 days
Sulfide	Add 2ml 1 *M* zinc acetate & 1 *N* NaOH to pH >9 Store at 4°C	7 days
Temperature	Det. on site	No holding
T. Kjeldahl Nitrogen	Add H_2SO_4 to pH <2 Store at 4°C	28 days
Turbidity	Store at 4°C	48 hours

[a] *FEDERAL REGISTER, Vol. 49, No. 209, Friday, October 26, 1984.*

DAVIS & FLOYD

Chain of Custody Form

816 East Durst Street, Greenwood, S.C. 29649 Phone (803)229-5211 Fax (803)229-7119

PROJ. NO.	PROJECT NAME

SAMPLERS NAME/AFFILIATION:(PRINTED)

SAMPLE NO.	DATE	TIME	GRAB	COMP.	SAMPLE DESCRIPTION	NO. OF BOTTLES	PARAMETERS															REMARKS	SAMPLE TYPE	POTENTIAL HAZARD

RELINQUISHED BY: (SIGNATURE)	DATE / TIME	RECEIVED BY: (SIGNATURE)	RELINQUISHED BY: (SIGNATURE)	DATE / TIME	RECEIVED BY: (SIGNATURE)

RELINQUISHED BY: (SIGNATURE)	DATE / TIME	RECEIVED FOR LAB BY: (SIGNATURE)	DATE / TIME	REMARKS

DW-DRINKING WATER WW-WASTE WATER HW-HAZARDOUS WATER SD-SOLID AB-ABSORBENT TUBE
GW-GROUND WATER RC-RCRA SW-SURFACE WATER IM-IMPINGER SOLUTION F -FILTERS

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APPENDIX I
TECHNICAL SPECIFICATIONS

BARITE HILL MINE
TECHNICAL SPECIFICATIONS
FOR CLOSURE OF THE PERMANENT HEAP LEACH FACILITIES
AS AN INDUSTRIAL WASTE LANDFILL

Prepared for:
Nevada Goldfields, Inc.
P.O. Box 1530
McCormick, South Carolina 29835

Prepared by:
Steffen Robertson and Kirsten (U.S.), Inc.
3232 South Vance Street
Lakewood, Colorado 80227

April, 1995
SRK Project No. 14115

I 2

The Technical Specifications entitled "Barite Hill Mine Technical Specifications for Closure of the Permanent Heap leach Facilities as an Industrial Waste Landfill" dated April 25, 1995, have been prepared for Nevada Goldfields, Inc. by Steffen Robertson and Kirsten (U.S.), Inc. under the direct supervision of Mr. Rob Dorey, Registered Professional Engineer in the State of South Carolina.

SOUTH CAROLINA
REGISTERED PROFESSIONAL ENGINEER
4/25/95
No. 11355
ROBERT DOREY

Rob Dorey, P.E. No. 11355

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1.0 INTRODUCTION

1.1 General

These Technical Specifications are for the closure of the permanent leach pad facilities as an industrial solid waste landfill for the Barite Hill Project located near McCormick, South Carolina. Closure and reclamation of these facilities shall be in the form of an industrial solid waste landfill conforming to these Specifications and the series of associated Drawings numbered 14115-001 to 14115-004, consecutively.

1.2 Scope of Work

The scope of work for these Technical Specifications shall include all earthwork, piping, and culverts required for the facility closure and reclamation including regrading, cover placement and revegetation. Specific work items include, but are not limited to the following:

- Mobilization of all equipment and material required for the work;
- Installation of temporary and permanent surface water control;
- Limited excavation in specific areas for diversion channels;
- Development of borrow areas outside the construction areas;
- Foundation preparation for fill placement;
- Heap leach pad area regrading and compaction;
- Fill placement and compaction for surface water control channels;
- Cover placement and compaction;
- Topsoil placement;
- Seeding and mulching;
- Riprap placement for channel and spillway lining;
- Furnishing and installing all material and constructing all items appurtenant and incidental to the above; and
- Demobilizing, which includes removal of temporary structures and shaping, contouring, grading final surfaces and revegetating these areas.

The Contractor shall familiarize himself with the relevant regional and site specific conditions which may have an impact upon the work. Data relevant to the overall project are contained in reports in the possession of the Owner, which are available for Contractor review. Of particular relevance to the work is the report, "Supporting Information for Application for Permit to Construct a Solid Waste Management System for the Barite Hill Project," by Steffen Robertson and Kirsten (U.S.), Inc. (SRK, 1995).

A significant part of the earthworks for the facility will involve regrading, placement and compaction of spent ore within the leach pad area. This work will involve regrading the existing 2H:1V heap slopes to 3H:1V, importing spent ore from the re-useable heap leach facility at the site and compaction of the regraded surface of the heap and side slopes. All or portions of this component of the work may be conducted by the Owner.
In the case of discrepancy or ambiguity in the Specifications, Drawings, codes, standards, or regulations, it is the intent of these Specifications that the most restrictive interpretation shall apply unless interpreted otherwise by the Design Engineer.

1.3 Definitions

The following definitions apply to these Specifications.

a. "Owner" is defined as an authorized representative of Nevada Goldfields, Inc. (NGI);

b. "Construction Manager" is defined as an authorized representative of the Owner responsible for coordinating the activities of the Contractor;

c. "Quality Assurance Inspector" is defined as a qualified representative appointed and authorized by the Owner to monitor the quality of the completed construction product;

d. "Design Engineer" is defined as the authorized representative of the Owner, who has designed the facilities to be constructed and prepared the plans and specifications;

e. "Contractor" is defined as the party or parties which have a contract agreement with the Owner and perform the actual construction activities.

f. "Specifications" is defined as this document of technical specifications prepared by Steffen Robertson and Kirsten (U.S.), Inc. for the Barite Hill Project dated April, 1995;

g. "Drawings" is defined as the drawings to be read in conjunction with these Specifications titled, "Barite Hill Mine Technical Specifications For Closure of the Permanent Leach Pad Facilities as an Industrial Solid Waste Landfill" and are in a series numbered 14115-01 through 14115-0__, consecutively;

h. "Spent ore" is defined as processed ore contained within the permanent or re-useable leach pad areas at the mine;

i. "Off-site material" is defined as material obtained from sources other than from the mine site;

j. All slopes are described in terms of horizontal distance: vertical distance; and

k. All sieve sizes refer to U.S. Standard sieve sizes.

1.4 Applicable Codes and Regulations

The work shall conform to applicable federal, state and local regulations. Test procedures shall conform to applicable ASTM standards, as documented in the edition of the standards in force at the start of work.

2.0 CONTRACTOR'S RESPONSIBILITY

The Contractor shall carefully examine all of the Technical Specifications and Drawings, and the site of the work. He shall fully inform himself as to the character of all conditions at the site, local and otherwise, affecting the execution of the work, including those conditions to which federal, state and local safety and/or health laws and regulations may be applicable. Failure to comply with the requirements of this section shall not relieve the Contractor of responsibility for complete performance of the work.

It shall be the sole responsibility of the Contractor to familiarize himself, by such means as he considers appropriate, with all matters pertaining to this work including, but not limited to:

- The location and nature of work;
- Applicable safety and health regulations;
- Availability of utilities;
- Erosion control measures;
- Dust abatement requirements;
- Subsoil conditions;
- Geologic conditions at the site;
- Water source required for construction;
- Climatic conditions;
- The nature and conditions of the terrain;
- Transportation and communication facilities;
- Location, availability, and condition of construction materials;
- Selective borrowing within approved borrow areas;
- Other construction or mining activities at the project site that may be underway simultaneously with the construction work for these facilities; and

- All other factors that may affect the cost, duration, and execution of the work.

Prior to the start of the work, the Contractor shall prepare for the Owner a schedule outlining the Contractors proposed sequence of construction activities such that the Owner can coordinate other activities at the site. The Contractor's construction schedule must meet the Owner's approval.

The Contractor shall ensure that it, its subcontractors and suppliers and their respective employees, agents and invitees comply with all applicable governmental laws, rules, regulations, orders and directives concerning health and safety. The Contractor shall take all responsible measures to prevent injury to all persons and property as a result of performance of the work, including without limitation the furnishing, at the Contractor's expense, of fences, flagmen, warning signs and barricades and the elimination of excessive dust and smoke emissions. The Contractor shall develop, submit and maintain for the duration of the work, a safety program that will effectively incorporate and implement all required safety provisions. The Contractor shall appoint an employee who is qualified and authorized to supervise and enforce compliance with the safety program.

The Contractor shall store materials, confine his equipment, maintain construction operations and the operations of workmen to limits indicated by law, ordinances, permits, or requested by the Quality Assurance Inspector, Construction Manager or Owner, and shall not unreasonably encumber the premises with his materials. Caution shall be exercised at all times to avoid blocking access and haul roads or in any other way interfering with the Owner's activities or the activities of other contractors. The Contractor shall not, at any time, engage or instigate activities that would, in the Construction Manager's or Quality Assurance Inspector's opinion, present a hazard to personnel, or operations, or to the public.

The Contractor shall meet with the Construction Manager and Quality Assurance Inspector to establish the extent of the above areas, and any other area which may impact the schedule or method of performing the work, to accommodate the work activities in the required areas.

The Contractor shall at all times keep the work site neat, tidy and free of waste materials or rubbish resulting from his work. Fuel, lubricating oils and chemicals shall be stored and dispensed in such a manner as to prevent or contain spills and prevent said liquids from reaching local streams or groundwater.

Prior to demobilization, the Contractor shall remove all trash, debris and waste material from the site and properly dispose of said material. The Owner shall have the right to determine what is waste material or rubbish and the manner and place of disposal. All material furnished for the execution of the work and thereby purchased by the Owner shall remain the property of the Owner.

The Contractor shall clean out all installations and tear down and remove all temporary structures built by the Contractor. The Contractor shall leave the site area in a condition at least as good as the condition prior to construction. The Contractor shall also grade the construction site to provide proper drainage and give a sightly appearance. The existing synthetic leach pad and solution pond liners as well as any existing structures or facilities to remain shall be protected against possible damage by the Contractor. Any damage to existing facilities which does occur as a result of the Contractor's activities or employees shall be repaired at the sole expense of the Contractor.

The final condition of the construction site is subject to the approval of the Owner.

3.0 INSPECTION OF WORK

3.1 General

Unless otherwise specified, full-time inspection of all construction activities defined by the Specification will be provided by the Owner. Owner's inspection of all work shall be performed under the supervision and control of the Quality Assurance Inspector or his designated representative while such work is in progress. Said inspections are for the convenience, satisfaction, and benefit of the Owner in determining that the work is performed in strict accordance with the Specifications. It shall be the Contractor's sole responsibility to provide all required materials (both natural and manufactured) and to perform all work in conformance with the Specifications. The Quality Assurance Inspector will inspect, test and report all findings to the Construction Manager. The Construction Manager shall be responsible for enforcing the Specifications or initiating variances or design changes through the Design Engineer. Owner's inspections shall not relieve the Contractor of responsibility for the acceptability of the finished work or portions thereof.

3.2 Access

The Quality Assurance Inspector and his representatives shall at all times have access to the work whenever it is in preparation or progress provided that they report their presence to the Construction Manager who is responsible for all activities on-site. The Contractor shall fully cooperate with the Quality Assurance Inspector, shall provide proper facilities for access, and shall furnish labor and equipment reasonably needed for safe and convenient inspection. The Contractor shall give the Quality Assurance Inspector ample notice of readiness of the work for inspection, and the Quality Assurance Inspector shall perform said inspections in such a manner as not to unnecessarily delay the work.

3.3 Examination

If any work should be covered up without prior approval or consent of the Quality Assurance Inspector, it must, if required by the Quality Assurance Inspector, be uncovered for examination.

3.4 Samples and Tests

It is the intent of these Specifications that materials shall be inspected and tested by the Quality Assurance Inspector before final acceptance of the work. Any item of the work which is found not to meet or exceed the Specifications or which is improperly located or constructed shall be removed and replaced. The Quality Assurance Inspector's tests and inspections shall not relieve the Contractor from full responsibility to furnish and install materials in conformance with these Specifications.

Construction quality control testing shall be conducted by the Quality Assurance Inspector during the course of the construction activities unless otherwise indicated in these Specifications. Quality control testing shall consist of, but is not limited to, determination of moisture-density relationships for compaction control, grain size analyses, agricultural soil analyses, concrete/grout compressive strength, and moisture content and density determinations for fill materials. Unless otherwise indicated, test procedures shall conform to applicable ASTM standards, as documented in the edition of the standards in force at the start of work.

3.5 Alteration to Drawings and Specifications

All alterations made to either the Specifications or Drawings shall be subject to the Design Engineer's approval and, where applicable, to the approval of governmental regulatory agencies. All alterations shall be issued under a covering work order signed by the Design Engineer.

4.0 ENVIRONMENTAL REQUIREMENTS

4.1 Control of Sediment

During the performance of the work defined by the Specifications or any operations appurtenant thereto, the Contractor shall provide all labor, equipment, material and means required to control erosion within the work areas and storm runoff sediment generation. The Contractor shall retain sediment at the construction site to the greatest degree possible through the adoption of "best management practices" (BMP's). The BMP's shall be utilized in addition to the erosion control measures defined in the Drawings. The BMP's may consist of, but are not restricted to, the following measures; silt fences, hay bale sediment traps, earth dikes, and diversions. These and other BMP's are described in detail in the report titled "Erosion and Sediment Control for Developing Areas" published by the South Carolina Land Resources Conservation Commission, Erosion and Sediment Control Division, and in the EPA guidance document entitled "Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices" available from the National Technical Information Service (NTIS).

4.2 Control of Fugitive Dust

During the performance of the work defined by these Specifications or any operations appurtenant thereto, whether on right-of-way provided by the Owner or elsewhere, the Contractor shall furnish all labor, equipment, materials, and means required, and shall perform proper and efficient measures wherever and as required to reduce the dust nuisance, and to prevent dust which has originated from the Contractor's operations from damaging land, vegetation, and dwellings, or causing a nuisance to persons. Dust shall be controlled to a degree acceptable to the appropriate regulatory agencies, and acceptable to the Construction Manager.

4.3 Limits of Work

The Contractor shall confine his equipment, apparatus, the storage of materials, and the operation of workmen to limits indicated by law, ordinances, permits or selected by the Construction Manager, and shall not unreasonably encumber the premises with his materials. Extreme caution shall be exercised at all times to avoid blocking plant or other roads or in any other way interfering with the Owner's operations or presenting a hazard to the Owner's personnel and equipment, or to the public.

4.4 Surface Water Control

Prior to beginning construction, the Contractor shall submit for approval a plan showing his proposed method for collection and disposition of surface waters that may affect the execution and completion of work. The plan may be placed in operation upon review and comment by the Construction Manager and Quality Assurance Inspector, but nothing in this section shall relieve the Contractor from full responsibility for the adequacy of the system.

Surface water control shall be accomplished in a manner that will result in all construction operations being performed free of excess moisture. The Contractor shall provide dewatering or surface diversions, as needed, at his own expense to maintain drained work areas.

The site is in a moderate climate area and anticipated to be dry at the time of construction; however, thunderstorms and runoff may occur during the construction period. The duration and severity of the thunderstorms vary and it shall be the Contractor's responsibility to protect his equipment and materials, as well as completed work or portions of the work in progress from damage in the event of such storms.

The Contractor shall sequence his construction activities to minimize erosion or runoff damage to the earthworks covered under these Specifications. In the event neglect or poor construction planning results in damage to the facilities constructed or being constructed, the facilities shall be repaired or replaced to the satisfaction of the Construction Manager, at the Contractor's expense. Plans for remedial work shall be submitted by the Contractor for review and approval by the Construction Manager prior to commencement of such work.

5.0 EXCAVATION

5.1 General

5.1.1 Scope of Work

The excavations to be performed include, but are not limited to, site preparation, removal of unsuitable materials located within the proposed construction limits, diversion ditches and channels, buried pipelines, and shaping and excavation or trenching in foundation areas and project borrow areas.

There shall be no classification of soil and rock excavations for these Specifications as to type, hardness, moisture condition or other characteristics affecting excavatability. The Contractor shall be solely responsible for determining the excavatability of soil and rock materials, water table conditions and other pertinent subsurface information.

5.1.2 Handling of Material

Insofar as is practicable in the permanent construction, the Contractor shall use materials obtained from required excavations which meet applicable specifications. Such materials may be placed in the designated final locations direct from the excavation, or may be placed in temporary stockpiles and later placed in the final location as approved by the Construction Manager. The Contractor shall schedule excavation operations so as to avoid or minimize stockpiling and rehandling of excavated material.

5.1.3 Lines and Grades

All open-cut excavations shall be performed in accordance with the Specifications to the lines, grades, and dimensions shown on the Drawings or as established by the Design Engineer or Construction Manager. Assumed excavation lines for the work are shown on the Drawings, but the final excavation may vary from the lines shown. The assumed final lines for excavation, shown on the Drawings, shall not be strictly interpreted as accurately indicating the final or actual lines of excavation. When unfavorable conditions are discovered, they shall be corrected by excavation to lines, depths, and dimensions prescribed by the Design Engineer or Construction Manager.

Unless noted otherwise or specifically prescribed by the Design Engineer or Construction Manager, the maximum permissible deviation from specified lines and grades shall be plus or minus 0.25 feet.

5.1.4 Cuts and Slopes

The Contractor shall inspect all temporary and permanent open-cut excavations on a regular basis for signs of instability. Should signs of instability be noted, the Contractor shall undertake remedial measures immediately and shall notify the Construction Manager as soon as possible. It will be the

Contractor's responsibility to remove all loose material from the excavation slopes and to maintain the slopes in a safe and stable condition at all times during the progress of the work.

5.1.5 Excess Excavation

All necessary precautions shall be taken to preserve the material below and beyond the lines of excavation in the soundest possible condition. Where excess excavation has been performed to complete the work, such areas shall be refilled with materials furnished and placed to the satisfaction of the Construction Manager.

5.1.6 Disposal of Excavated Materials

Excavated materials that are unsuitable for, or are in excess of, permanent construction requirements shall be wasted. Waste piles shall be located outside the limits of the fill areas as shown on the Drawings, or as approved by the Construction Manager, where they will not interfere with the operation of the Owner's facilities, and where they will neither detract from the appearance of the completed project nor interfere with the accessibility of the various parts of the work. Waste piles shall be graded and trimmed to reasonably regular lines and stable slopes.

5.2 Site Preparation

Site preparation activities shall consist of clearing, grubbing, and stripping for the fill areas, buried pipeline and surface water diversions as shown on the Drawings. Clearing involves removal of surface vegetation by a method that mulches the vegetation for inclusion in the topsoil stockpile. Clearing also involves removing any rubbish or debris unsuitable for inclusion with topsoil materials, as determine by the Quality Assurance Inspector, and isolating this material from other materials for proper disposal. Grubbing involves removal of brush and tree roots in excess of ½ inch in diameter in the subsoils. Stripping involves removal of organic soils, or otherwise unsuitable foundation materials, as determined by the Quality Assurance Inspector. An organized topsoil stripping pattern with grade stakes shall be implemented by the Contractor as approved by the Quality Assurance Inspector to ensure that topsoil is removed without over excavation.

Clearing, grubbing, and stripping limits shall extend 5 ft beyond diversion structures, access roads, and other facilities.

The vegetative and topsoil materials removed during clearing, grubbing and stripping shall be removed and stored in topsoil stockpile areas meeting the approval of the Construction Manager. Topsoil stockpiles may be created in small localized stockpiles within or adjacent to areas of disturbance, within pre-existing topsoil stockpiles, or in other areas meeting the Construction Manager's approval. Topsoil stockpiles shall not be placed in areas of concentrated storm run-off, nor blocking access roads, haul roads or other of the Owner's facilities, nor interfere with the Owner's operations or work of other contractors. Topsoil stockpiles shall be placed with maximum side slopes of 3H:1V and surrounded with surface water diversion structures and silt fences meeting the approval of the Quality Assurance Inspector.

Alternatively, topsoil may be placed directly within the areas requiring topsoil placement once these areas have been graded. If handled in this fashion the topsoil must be promptly seeded and covered with mulch as per the Revegetation Specifications.

5.3 Access Roads

Contractor's access roads shall be planned such that construction of said roads shall coincide as much as practicable with the construction of the permanent roads associated with the project and other required excavation. Prior to development of access roads, the Contractor shall submit a plan showing their location and size for the Construction Manager to issue for the Owner's approval.

5.4 Borrow Areas

To the extent practicable, earth and rock materials required for the work defined by these Specifications which are not obtainable from required excavations shall be obtained primarily from on-site borrow areas designated by the Construction Manager. Materials not available from said borrow areas shall be furnished by the Contractor from a source proposed by the Contractor and approved by the Quality Assurance Inspector. The Owner may elect to furnish any or all borrow from the mining operations or ancillary areas of the property.

The Contractor may select and use any borrow area approved by the Quality Assurance Inspector for construction materials, provided the materials meet the specification requirements for the intended use.

6.0 FILL PLACEMENT

6.1 General

6.1.1 Scope

The heap regrading, diversion channels, spillways, culverts and other appurtenant facilities incorporate different types of fill material as specified herein. Fill materials shall be obtained from approved sites and local borrow areas or imported. Riprap shall be either obtained from borrow areas located within the site, obtained from waste rock produced in conjunction with mining activities at the site, or imported. Selective borrowing or processing of materials may be required. All fill material shall be subject to the approval of the Construction Manager and the Quality Assurance Inspector.

Borrow areas shall be established, as necessary, for riprap, bedding and drain materials, and soil liner/cap material. The location, physical dimensions, and depth of stripping shall be identified by the Contractor and approved by the Quality Assurance Inspector prior to commencement of work requiring such borrow material. Within borrow areas, cut slopes shall be maintained at 2H:1V or less.

Fill shall be of inorganic soil or rock materials. The suitability of all materials intended for use in fill construction shall be subject to approval by the Quality Assurance Inspector. Except as otherwise specified or approved by the Quality Assurance Inspector, fill materials shall be placed on moist surfaces.

The work covered by this section of the Specifications shall include, but is not limited to, fill placement for the leach pad regrading, surface water runoff diversions, drainage blanket material, riprap and filter placement, reworking in-place foundation materials and earthwork incident thereto. The fill materials shall be categorized as follows:

- Type 1 - Spent ore fill;
- Type 2 - Structural fill;
- Type 3 - Soil liner fill;
- Type 4 - Granular fill;
- Type A Riprap;
- Type B Riprap;
- Type C Riprap;
- Type D Riprap;
- Type E Riprap bedding/filter material; and
- Type F Riprap bedding/filter material.

6.1.2 Lines and Grades

Fill materials shall be placed to the lines, grades, and cross-sections shown on the Drawings or as specified herein.

6.1.3 Foundation Preparation

Upon the completion of the required foundation clearing, stripping and excavation operations and removal of unsuitable foundation material, construction area surfaces composed of spent ore, native soil materials, or fill materials shall be scarified to a minimum depth of 12 inches, moisture conditioned to near optimum moisture content, and recompacted to at least 95 percent of maximum dry density (ASTM D-698). In areas where the surface is composed of intact rock, fill placement shall be commenced following the completion of clearing or stripping activities. No new fill shall be placed in the foundation areas until the foundation has been inspected and approved by the Quality Assurance Inspector.

6.1.4 Placement

The procedures for the construction of required fills shall be approved by the Quality Assurance Inspector prior to fill placement.

No fill materials shall be placed until the foundation and subgrade preparations, within the area of placement, have been completed and approved by the Quality Assurance Inspector. Subsequent placement of fill shall be made only in areas approved by the Quality Assurance Inspector. Placement of the fill shall be done to the lines and grades shown on the Drawings. The procedures for the construction using fill materials shall be discussed with, and approved by, the Quality Assurance Inspector prior to placement. Placement of all fill materials shall include benching or keying-in procedures as directed by the Quality Assurance Inspector to provide for bonding between old and new fill as well as fill to natural material.

Fill shall be placed in near horizontal lifts unless otherwise approved by the Quality Assurance Inspector. Riprap may be placed parallel to slopes. Fill placement procedures and equipment shall be organized and suitable for constructing a relatively uniform fill, meeting minimum density and/or compactive effort requirements, as specified. With the exception of riprap, fill surfaces shall be graded to drain as materials are placed and fill of one type shall not be placed more than one lift in advance of an abutting fill material of a different type. The Contractor shall dewater or provide drainage for ponded water conditions in fill areas.

No deleterious or unsuitable materials shall be placed in the fills. The suitability of all fill materials intended for use in the construction work shall be subject to approval by the Quality Assurance Inspector. Fill placement shall be temporarily stopped, due to unsuitable weather conditions, at the discretion of the Quality Assurance Inspector. Under marginal weather conditions, the Contractor may place fill provided the fill, when tested, meets Specification.

The distribution of materials shall be such that the fill is free from lenses, pockets, streaks, or layers of material differing substantially in texture or gradation from the surrounding material. The combined borrow excavation and fill placement operation shall be such that the materials, when compacted in the fill, shall be blended sufficiently to secure the best practicable distribution of the material, subject to the approval of the Quality Assurance Inspector.

Riprap shall be placed in a manner which will avoid segregation and accumulation of the larger or smaller stone sizes. Riprap placement shall include final grading to result in a relatively uniform surface free of stones which protrude significantly above adjacent stones and meets the approval of the Quality Assurance Inspector.

If, in the opinion of the Quality Assurance Inspector, the surface of the prepared foundation or the surface of any layer of the fill is too dry or too smooth to bond properly with the layer of material to be placed thereon, it shall be moistened and/or worked with harrow, scarifier, or other equipment to provide a satisfactory bonding surface before the next layer of fill material is placed. If, in the opinion of the Quality Assurance Inspector, the surface of the prepared foundation or the rolled surface of any layer of the fill in place is too wet for proper compaction of the layer of fill material to be placed thereon, it shall be removed and allowed to dry or shall be worked with harrow, scarifier, or other equipment to reduce the moisture content to the required amount, and then compacted before the next layer of fill material is placed.

6.1.5 Moisture Control

During compaction operations, fill materials shall be maintained or conditioned within the moisture content range required to permit proper compaction to the specified density. The moisture content of the fill material prior to and during compaction shall be uniform throughout the material.

When material is too dry for proper compaction, the Contractor shall spray water on the fill and work the moisture into the fill by harrowing, discing, or other approved means until a uniform distribution of moisture is obtained. Material that is too wet for proper compaction shall be removed from the fill or the material may be spread and permitted to dry, assisted by discing and harrowing, if necessary, until the moisture content is reduced to an amount suitable for obtaining the specified degree of compaction and is relatively uniformly and evenly distributed throughout the fill material.

6.1.6 Compaction

Where necessary, after fill material has been placed and spread, or reworked in-place and moisture conditioned as specified, the fill material shall be compacted by passing compaction equipment over the entire surface of the layer a sufficient number of times to obtain the required density, as determined by the Quality Assurance Inspector on the basis of field density tests and his observation of the fill operations.

The frequency of field density tests performed on each type of material shall be as required by the Quality Assurance Inspector.

The Quality Assurance Inspector will continuously evaluate the Contractor's equipment and methods. If such equipment or methods are found unsatisfactory for the intended use, the Contractor shall be required to replace the unsatisfactory equipment with other types or adjust methods until proper compaction is achieved.

Compaction shall be based on ASTM D-698 or compactive effort as approved by the Quality Assurance Inspector. In-place fill densities may be determined by the Sand Cone or Nuclear Gauge Methods. The Contractor shall construct test fills, as determined by the Quality Assurance Inspector, for fills outside the testing limits of ASTM D-698, for establishing compactive effort procedures. The USBR Rapid Method may be used in conjunction with the Standard Proctor Compaction Method to determine percent compaction.

6.1.7 Special Compaction Equipment

Only hand-guided mechanical tampers or hand-guided vibratory rollers shall be used for compaction around, over, near, or adjacent to pipes, culverts, and/or concrete structures.

6.1.8 General Sequence of Fill Operations

The Contractor shall construct the fill areas such that the fill is approximately level at all times during construction. The fill surfaces shall be graded to prevent ponding of precipitation.

The Contractor shall leave the surface of compacted fill, at the end of each shift or day, in such a manner as to prevent an excessive increase in moisture content arising from precipitation. The Quality Assurance Inspector may require that the top layer of the fill be removed at the recommencement of fill placement if it has become too wet or is softened as a result of precipitation.

In areas of fill placement over the existing synthetic liner no vehicular or equipment traffic shall be permitted on the liner surface. Initial fill placement directly over the synthetic liner shall be performed only with low ground pressure equipment meeting the approval of the Quality Assurance Inspector and shall be placed in lifts with a minimum thickness of 2 ft. Damage which occurs to the synthetic liner as a result of the Contractor's activities shall be repaired at the Contractor's expense.

6.1.9 Contamination

The Contractor shall route equipment and take all actions necessary to prevent material of one type from being deposited inadvertently, either by dumping or through travel of equipment, in or on material of another type. Such improperly deposited material shall be removed from the fill areas as required by the Quality Assurance Inspector. Said removed material shall be wasted in approved disposal areas.

All stones of such dimensions that interfere with compaction in the layer thicknesses specified, as determined by the Quality Assurance Inspector, shall be removed prior to compaction of the fill.

6.1.10 Conduct of Work

The Contractor shall maintain and protect fills in a condition satisfactory to the Quality Assurance Inspector at all times until the final completion and acceptance of the work. Any approved fill material which becomes unsuitable for any reason whatsoever, after being placed in the fill and before final acceptance of the work, shall be removed and replaced by the Contractor in a manner satisfactory to the Quality Assurance Inspector.

6.2 Fill Materials

6.2.1 Material Type 1 - Spent Ore Fill

The Contractor shall furnish, transport and place Type 1 material to the lines and grades and in the locations shown on the Drawings and set forth in the Specifications, or as specified by the Quality Assurance Inspector.

Material Type 1 fill shall consist of spent ore obtained through regrading of the existing permanent ore heap or from the re-useable leach pad facility. Spent ore fill shall be used exclusively for regrading the permanent ore heap from the existing conditions to 3H:1V maximum side slopes as shown in the Drawings. Spent ore fill shall not be placed beyond the confines of the synthetically lined leach pad area. Placement of spent ore fill shall be subject to the Quality Assurance Inspector's approval.

In areas requiring spent ore fill placement directly over the existing synthetic liner no vehicular or equipment traffic shall be permitted on the liner surface. Spent ore placement directly over the synthetic liner shall be performed only with low ground pressure equipment meeting the approval of the Quality Assurance Inspector and shall be placed in lifts with a minimum thickness of 2 ft. Damage which occurs to the synthetic liner as a result of the Contractor's activities or employees shall be repaired at the Contractor's expense.

Spent ore in lifts greater than 2 ft above the synthetic liner shall be placed in a moderately dense state by trafficking with construction equipment and haulage vehicles and shall be subject to the Quality Assurance Inspector's approval. The final regraded surface of the spent ore, including those areas which remain undisturbed from existing conditions or underlie the runoff diversion channels or spillway, shall be scarified to a minimum depth of 12 inches and compacted to 95 percent of the maximum dry density, ASTM D-698 or USBR Rapid Construction Method as directed by the Quality Assurance Inspector, within 3 percent of optimum moisture content using approved compaction equipment. A minimum of 1 ft of compacted spent oxide ore from the re-useable leach pad facility shall be placed over the compacted surface of all heap areas containing sulfide ore as directed by the Construction Manager.

The Contractor shall be responsible for maintaining the integrity of the compacted surface of the Type 1 spent ore material prior to final acceptance and covering with Material Type 3. Any degradation of the compacted spent ore material which occurs, either from erosion due to storm runoff, excessive moisture uptake or desiccation, shall be rectified at the Contractor's expense.

6.2.2 Material Type 2 - Structural Fill

The Contractor shall furnish, transport and place Type 2 material to the lines and grades and in the locations shown on the Drawings and set forth in the Specifications, or as specified by the Quality Assurance Inspector. Material Type 2 structural fill shall be utilized for the surface water diversion channel spillway fill adjacent to the southwest side of the existing pregnant solution pond or backfill for the buried pipeline from Waste Area C.

Material Type 2 fill shall consist of natural soil and rock materials generated from the various excavations required for the project which fails to meet the specifications for other material types or is in excess of the needs for these other material types. Material Type 2 fill may also consist of similar materials generated by the Owner's mining activities or the work of other contractors at the site, as directed by the Construction Manager. The maximum allowable particle size for Type 2 material shall be 12 inches and the material shall be reasonably well graded with a maximum of 50 percent by weight finer than a No. 200 sieve size, otherwise no specific gradation is specified.

Material Type 2 shall be compacted to a minimum density of 95 percent of the maximum dry density, ASTM D-698 or USBR Rapid Construction Method as directed by the Quality Assurance Inspector, within 5 percent of optimum moisture content using approved compaction equipment. Fine grained Type 2 material shall be placed in maximum 8-inch loose lifts. Coarse grained Type 2 material shall be placed in maximum 12-inch loose lifts.

6.2.3 Material Type 3 - Soil Liner

The Contractor shall furnish, transport and place Type 3 material to the lines and grades and in the locations shown on the Drawings and set forth in the Specifications, or as specified by the Quality Assurance Inspector. Material Type 3 shall consist of a compacted low-permeability soil liner/cap placed over the entire ore heap following regrading. Type 3 material must completely cover all spent ore and extend beyond the limits of the synthetic leach pad liner. Type 3 material may be placed in lifts which are parallel to the foundation slope.

Material Type 3 shall consist of natural fine-grained soil material obtained from on-site borrow sources as directed by the Construction Manager. Type 3 material shall consist of relatively uniform material free of stones, rocks, or blocks and clumps of soil in excess of 4 inches, otherwise no gradation is specified. Type 3 material placed in direct contact with the synthetic leach pad liner shall have a maximum particle size of 3/4 inch. Type 3 material shall exhibit a maximum permeability of 5×10^{-6} cm/sec when placed and compacted in the manner adopted by the Contractor and as verified by the Quality Assurance Inspector.

Type 3 soil liner/cap fill shall be placed in 6-inch maximum loose lifts and compacted to minimum density of 95 percent of maximum dry density (ASTM D-698) and within plus 5 percent of optimum moisture content. Type 3 soil liner/cap fill placed in direct contact with the synthetic leach pad liner shall be placed in 12-inch maximum loose lifts and subject to the same compaction criteria. Any damage to the synthetic liner as a result of the Contractor's activities or personnel shall be repaired at the Contractor's expense.

The Contractor shall be responsible for maintaining the integrity of Type 3 soil liner/cap material following placement and prior to acceptance and covering with the next lift or topsoil in the case of the final lift. Any degradation of the Type 3 material which occurs, either from erosion due to storm runoff, excessive moisture uptake or desiccation, shall be rectified at the Contractor's expense. The Contractor shall also be responsible for repairing all perforations of the soil liner including nuclear density device probe holes, BAT permeability test holes, drive tube sample locations, sand-cone holes, permeability sampling locations, and grab sample locations, whether caused by the Contractor's workforce or others. Perforations shall be repaired by backfilling with a soil-bentonite mixture containing not less than 50 percent bentonite by volume. The soil-bentonite mixture shall be tamped in place with a tamping rod, proctor hammer, or hand tamper depending on the size of the perforation.

6.2.4 Material Type 4 - Granular Fill

Material Type 4 granular fill shall be used as drainage blanket fill directly over the synthetic liner and perforated drainage pipes in the downslope toe area of the heap. Material Type 4 granular fill shall also be used as backfill adjacent to the "culverts" (PVC pipe segments) leading from the leach pad to the solution ponds and the pipe leading from Waste Area C to the existing rinse pond. Type 4 fill shall be obtained by crushing or screening selected on-site materials, including spent ore, waste rock from the mining activities or materials derived from mandatory excavations, or imported.

Type 4 material shall consist of hard, durable, natural sand and gravel or crushed rock materials with a maximum particle size of 3/4 inch. Material Type 4 fill shall have a minimum hydraulic conductivity of 1×10^{-4} cm/sec.

Type 4 material shall conform to the following material specifications:

U.S. Standard Sieve or Screen Opening	Percentage Passing by Weight
3/4 inch	100
1/2 inch	75-100
No. 4	50-100
No. 40	25-75
No. 200	0-25

Type 4 material shall be utilized as drainage blanket fill directly over the exposed liner at the toe of the heap. When utilized as drain fill, Type 4 material shall be placed to a minimum thickness of 2 ft in a single lift directly on the synthetic liner in a loose, non-compacted condition using low ground pressure equipment approved by the Quality Assurance Inspector . The Contractor must route construction equipment and vehicle traffic in such a manner as to avoid excessive trafficking and compaction of the material and damage to the synthetic liner system. Any damage to the synthetic liner as a result of the Contractor's activities or personnel shall be repaired at the Contractor's expense.

Type 4 material shall be utilized as backfill material within a minimum of 1 foot of the pipes or pipe culverts. Compaction of backfill within a minimum of 1 ft of these pipes shall be accomplished by hand-operated compaction equipment as approved by the Quality Assurance Inspector. Initial loose-lift thickness of backfill material shall not exceed 12 inches and shall not exceed 6 inches for each subsequent lift to a minimum of 1 ft above the pipe. The Type 4 backfill material shall be compacted to a minimum density of 95 percent of the maximum dry density (ASTM D-698) within 5 percent of optimum moisture content. The Type 4 material shall be placed and compacted carefully and simultaneously on each side of the pipe, to avoid significant lateral displacement, deformation, or damage to the pipe. Any damaged pipe shall be repaired or replaced by the Contractor, as specified by the Quality Assurance Inspector, at the Contractor's expense.

6.2.5 Type A Riprap

The Contractor shall furnish, transport and place Type A riprap material as set forth in the Specifications, the Drawings, or as specified by the Quality Assurance Inspector.

Type A riprap shall be utilized as the channel lining for the upper portion of the heap diversion spillway channel, i.e. in the spillway channel from the upper surface of the heap down to the lateral beach. Type A riprap material shall consist of hard, durable rock fragments obtained from on-site borrow sources, from approved mine waste stockpiles at the site, or imported.

Type A riprap material shall meet the following gradation requirements:

ROCK PARTICLE SIZE (IN CHES)	% SMALLER BY WEIGHT
18-24	100
16-22	85
12-18	50
4-6	15

Type A riprap shall be placed to a minimum thickness of 24 inches. Type A riprap material shall be placed in a dense configuration by trafficking with a smooth drum roller, track mounted equipment or large track hoe bucket and shall be subject to the Quality Assurance Inspector's approval. Alternative means for achieving a dense configuration, such as hand placement, may be adopted but are subject to the approval of the Quality Assurance Inspector. The final surface of riprap lined slopes or channels shall be free of individual stones which protrude significantly above-adjacent stones and must meet the approval of the Quality Assurance Inspector. The Contractor may utilize grouted riprap as specified in Section 7 of these Specifications in lieu of Type A riprap.

6.2.6 Type B Riprap

The Contractor shall furnish, transport and place Type B riprap material as set forth in the Specifications, the Drawings, or as specified by the Quality Assurance Inspector.

Type B riprap shall be utilized as the channel lining for the lower portion of the heap diversion spillway channel, i.e. in the spillway channel from the lateral bench on the heap down to the solution ponds. Type B riprap material shall consist of hard, durable rock fragments obtained from on-site borrow sources, from approved mine waste stockpiles at the site, or imported. Type B riprap material shall meet the following gradation requirements:

ROCK PARTICLE SIZE (INCHES)	% SMALLER BY WEIGHT
28-36	100
24-32	85
18-26	50
6-9	15

Type B riprap shall be placed to a minimum thickness of 36 inches. Type B riprap material shall be placed in a dense configuration by trafficking with a smooth drum roller, track mounted equipment o r large track hoe bucket and shall be subject to the Quality Assurance Inspector's approval. Alternative means for achieving a dense configuration, such as hand placement, may be adopted but are subject to the approval of the Quality Assurance Inspector. The final surface of riprap lined slopes or channels shall be free of individual stones which protrude significantly above adjacent stones and must meet the approval of the Quality Assurance Inspector. The Contractor may utilize grouted riprap as specified in Section 7 of these Specifications in lieu of Type B riprap.

6.2.7 Type C Riprap

The Contractor shall furnish, transport and place Type C riprap material as set forth in the Specifications, the Drawings, or as specified by the Quality Assurance Inspector.

Type C riprap shall be utilized as the channel lining for the surface water diversion channels located along the east side of the heap and solution ponds. Type C riprap material shall consist of hard, durable rock fragments obtained from on-site borrow sources, from approved mine waste stockpiles at the site, or imported. Type C riprap material shall meet the following gradation requirements:

ROCK PARTICLE SIZE (INCHES)	% SMALLER BY WEIGHT
16-20	100
14-18	85
10-15	50
3-5	15

Type C riprap shall be placed to a minimum thickness of 24 inches. Type C riprap material shall be placed in a dense configuration by trafficking with a smooth drum roller, track mounted equipment or large track hoe bucket and shall be subject to the Quality Assurance Inspector's approval. Alternative means for achieving a dense configuration, such as hand placement, may be adopted but are subject to the approval of the Quality Assurance Inspector. The final surface of riprap lined slopes or channels shall be free of individual stones which protrude significantly above-adjacent stones and must meet the approval of the Quality Assurance Inspector. The Contractor may utilize grouted riprap as specified in Section 7 of these Specifications in lieu of Type C riprap.

6.2.8 Type D Riprap

The Contractor shall furnish, transport and place Type D riprap material as set forth in the Specifications, the Drawings, or as specified by the Quality Assurance Inspector.

Type D riprap shall be utilized as the channel lining for the surface water diversion channels located along the southwest side of the heap and solution ponds and as the rock for grouted riprap where utilized for channel lining. Type D riprap material shall consist of hard, durable rock fragments obtained from on-site borrow sources, from approved mine waste stockpiles at the site, or imported. Type D riprap material shall meet the following gradation requirements:

ROCK PARTICLE SIZE (INCHES)	% SMALLER BY WEIGHT
12-16	100
10-14	85
8-12	50
3-5	15

Type D riprap shall be placed to a minimum thickness of 24 inches. Type D riprap material shall be placed in a dense configuration by trafficking with a smooth drum roller, track mounted equipment or large track hoe bucket and shall be subject to the Quality Assurance Inspector's approval. Alternative means for achieving a dense configuration, such as hand placement, may be adopted but are subject to the approval of the Quality Assurance Inspector. The final surface of riprap lined slopes or channels shall be free of individual stones which protrude significantly above-adjacent stones and must meet the approval of the Quality Assurance Inspector.

6.2.9 Type E Riprap Bedding and Filter Material

The Contractor shall furnish, transport and place Type E Riprap Bedding and Filter material as set forth in the Specifications, the Drawings, or as specified by the Quality Assurance Inspector.

Type E bedding/filter material shall be utilized as a bedding layer beneath Type A and B riprap in the heap spillway. Type E riprap bedding/filter material shall consist of hard, durable natural gravel material or rock fragments obtained from on-site borrow sources, from approved mine waste stockpiles at the site, or imported.
Type E riprap bedding/filter material shall meet the following gradation requirements:

ROCK PARTICLE SIZE (INCHES)	% SMALLER BY WEIGHT
2	100
1.5	100 - 85
.75	75 - 50
.5	45 - 15
.2	<15

Type E riprap bedding material utilized as bedding beneath Type A or B riprap shall be compacted by repeated passes of track mounted equipment or vibratory rollers and have a minimum compacted thickness of 9 inches. Compaction of Type E riprap filter/bedding material shall meet the approval of the Quality Assurance Inspector.

6.2.10 Type F Riprap Bedding and Filter Material

The Contractor shall furnish, transport and place Type F Riprap Bedding and Filter material as set forth in the Specifications, the Drawings, or as specified by the Quality Assurance Inspector.

Type F bedding/filter material shall be utilized as a bedding layer beneath Type C and D riprap and grouted riprap in the surface water diversion channels and spillways. Type F riprap bedding/filter material shall consist of hard, durable natural gravel material or rock fragments obtained from on-site borrow sources, from approved mine waste stockpiles at the site, or imported. Type F riprap bedding/filter material shall meet the following gradation requirements:

ROCK PARTICLE SIZE (INCHES)	% SMALLER BY WEIGHT
1	100
.75	100 - 85
.5	75 - 50
.25	50 - 20
.1	<15

Type F riprap bedding material utilized as bedding beneath Type C or D riprap shall be compacted by repeated passes of track mounted equipment or vibratory rollers and have a minimum compacted thickness of 9 inches. Type F riprap bedding material utilized as bedding beneath grouted riprap shall have a minimum compacted thickness of 12 inches. Compaction of Type F riprap filter/bedding material shall meet the approval of the Quality Assurance Inspector.

7.0 GROUTED RIPRAP

The Contractor may utilize grouted riprap for channel erosion protection in lieu of riprap types A, B, or C and shall use grouted riprap for lining the barren pond spillway. Rock for use in grouted riprap shall meet or exceed the size requirements for Type D riprap with the exception that the material shall be free of stones smaller than one inch.

Grouted riprap for use in spillways or channel sections with a grade steeper than 20 percent shall have a 3 ft deep grouted riprap cut-off at a maximum down slope spacing of 30 ft as shown in the Drawings or as directed by the Quality Assurance Inspector. These cut-offs shall be provided with a 4 inch diameter transverse drain pipe immediately upstream of the cut-off which is connected to a 4 inch diameter pipe outlet daylighting in the bottom of the spillway or channel as shown in the Drawings.

The grouted riprap shall be underlain by a minimum 12 inch thick filter layer consisting of Type F riprap bedding/filter material which is underlain by filter fabric and overlain by several layers of burlap, a filter fabric, or other suitable material (subject to the Quality Assurance Inspector's approval) to prevent grout contamination of the filter layer, as shown in the Drawings. The geotextile filter fabric shall meet the following specifications:

Mullen Burst Strength (ASTM D37896):	**550 psi**
Puncture Strength (ASTM D4833):	**175 lb**
Grab Tensile Strength/Elongation (ASTM D4533):	**275 lb/50%**
Apparent Opening Size (ASTM D4751)	
U.S. Standard Sieve Size:	**100**

Permittivity (ASTM D4491) (75 gm/ft^2)	**1.0 sec $^{-1}$**
UV Resistance (ASTM D4355):	
% retained after 150 hours:	**70%**

The subgrade in areas to be overlain with grouted riprap shall be graded and compacted to form a uniform surface free of irregularities and protuberances. Upon meeting the approval of the Quality Assurance Inspector, the prepared subgrade shall be overlain with a minimum 12.0 oz/square yard non-woven geotextile filter fabric meeting the approval of the Quality Assurance Inspector.

The overlying Type F riprap bedding/filter material shall be carefully placed to avoid damaging the filter fabric. Filter fabric which is damaged due to poor placement procedures shall be replaced at the Contractor's expense, to the satisfaction of the Quality Assurance Inspector.

Grout for grouted riprap shall consist of one part type II sulfate resistant Portland cement and three parts of sand thoroughly mixed with water to a thick creamy consistency (approximately 3-7 inch slump). The grout mix shall utilize the minimum amount of water necessary to produce a flowable mixture to reduce shrinkage as the grout hardens. Consistency of the grout is subject to the approval of the Quality Assurance Inspector. The grout should contain 4 percent air entrainment and have a minimum 28-day strength of 2000 psi. The Contractor shall submit design mix test records from the actual grout production facility which will be utilized to the Quality Assurance Inspector for approval prior to any actual grout placement.

Aggregate for grouted riprap shall meet the following gradation requirements and conform to the specifications for fine aggregate for concrete presented in AASHTO M-6 or ASTM C-33.

U.S. STANDARD SIEVE SIZE	% SMALLER BY WEIGHT
⅜"	100
#4	95 - 100
#8	80 - 100
#16	45 - 80
#50	10 - 30
#100	2 - 10
#200	0 - 5

The grout shall be delivered to the place of final deposit by use of chutes, tubes, buckets, pneumatic equipment, pumping or any other mechanical method which will control segregation and uniformity of the grout. The rock shall be wetted immediately prior to the grouting operation. The grout shall be placed in sufficient quantities to completely fill the voids between rocks. The grout shall be spaded or rodded into the interstices between stones to completely fill the voids. Exterior stones should be brushed to remove excess grout. The finished grouting operations shall leave face stones exposed for one-fourth to one-third their depth.

Grout shall be placed when temperatures are in excess of 35°F and rising. Grout shall not be placed if the grout temperature is 90°F or higher. Grout should be protected from freezing and cured as for concrete using approved sealants, blankets and curing procedures. After grouting is completed no load shall be placed on the grouted riprap until the grout has cured.

8.0 PIPING

8.1 Drain Pipes

The leach pad drain pipes shall consist of corrugated and perforated polyethylene agricultural drain pipes as manufactured by Advanced Drainage Systems, or approved equivalent. These pipes shall be wrapped with a filter fabric sock as provided by the manufacturer. The drain pipe network shall consist of 3-inch diameter laterals connected to 6-inch diameter main pipes. These pipes shall be lain at a minimum grade of 0.5 percent directly on the synthetic liner where exposed at the downslope toe of the heap as directed by the Quality Assurance Inspector or Construction Manager. The pipes shall be aligned with the existing drain pipes daylighting at the toe of the heap to the greatest extent practical. The 6-inch diameter main drain pipes shall discharge into the PVC pipe culvert leading to the rinse solution pond.

The drain pipe spacing will be based on the hydraulic conductivity of the Type 4 drainage blanket material as determined by the Quality Assurance Inspector. For a drainage blanket permeability of 1×10^{-4} cm/sec, drain pipe spacing will be 9 ft. For a drainage blanket permeability of 1×10^{-3} cm/sec, drain pipe spacing will be 33 ft.

8.2 Pipe Culverts

Pipe culverts consisting of 12-inch diameter schedule 80 PVC pipes and couplings shall be placed directly on the synthetic liner in the existing solution collection channels leading to the heap leach facility solution ponds. The culverts shall be installed through a piece of 40-mil ultra-violet resistant PVC liner using a PVC pipe boot. The PVC liner shall be installed directly on backfill placed within the solution channel to the approximate lines and grades of the existing heap perimeter berm and joined to the existing PVC liner, following the manufacturer's recommendations, to effectively seal the solution channel.

Similarly, the existing overflow channels connecting the pregnant and rinse solution ponds to the barren pond must be blocked with backfill and a piece of 40-mil UV PVC liner joined to the existing PVC channel liner.

8.3 Waste Area C Pipeline

A pipeline consisting of a 12-inch diameter PVC pipe and couplings, or approved equivalent, shall be installed from the existing Waste Disposal Area C facility to the rinse pond replacing the existing solution channel leading to the barren pond. This pipeline shall be buried at a minimum depth of 2 ft above the top of the pipe and placed at a minimum grade of one percent. Where the pipeline will be crossed by the surface water diversion from the east side of the heap leach pad a minimum depth of 6 ft below the existing ground surface is required.

The pipeline shall be installed through a PVC pipe boot and piece of UV-resistant PVC liner. The PVC liner shall be placed directly on material Type 3 backfill completely blocking the channel and securely anchored into the soil liner at the waste disposal facility to effectively seal the solution channel. A minimum thickness of 1 ft of Type 3 fill shall be placed over the PVC liner to form a soil liner continuous with the existing waste disposal area soil liner.

The position of the buried pipeline shall be marked in the field for future location using clearly labeled 3-ft high metal stakes or posts spaced at 50 ft intervals.

9.0 SURFACE WATER DIVERSIONS

9.1 General

Closure of the existing heap leach facilities includes construction of several runoff interception and routing channels as shown in the Drawings. These surface water control features must be developed in a sequential fashion as the ore heap is regraded and capped to isolate and route runoff from areas of the heap which have been capped. These surface water control facilities will predominantly consist of grass-lined channels with a triangular or trapezoidal cross-section.

The grass-lined channels will be prepared for seeding as per the following revegetation specifications and seeded at twice the rate specified in those specifications. Following seeding and mulching, the channel shall be "lined" with jute netting, excelsior blankets, straw or coconut fiber mats, a synthetic erosion liner or other similar materials as approved by the Quality Assurance Inspector. These erosion control mats shall be securely anchored at a maximum spacing of 2 ft with 11-gauge wire staples having a minimum length of 6 inches.

Steeper portions of the surface water control channels (greater than 3 percent grade) and the spillways shall be lined with riprap or grouted riprap as shown in the Drawings, as directed by the Quality Assurance Inspector, or specified herein.

9.2 Sequencing

The surface water control channels must be developed in a sequential fashion as the ore heap is regraded and capped. Regrading and capping will begin from the southwest and proceed to the northeast side of the heap. As regrading and capping progresses, the associated surface water control facilities should be developed concurrently.

At the point where the western 1/3 of the ore heap has been regraded and capped, the lateral bench drainage channel and the toe drainage channel at the base of the heap around the western side of the heap should be completed. Similarly, the "heap spillway" and channel from the upper heap surface to the barren pond and the barren pond spillway should be completed. In addition, the overflow channels connecting the pregnant and rinse solution ponds to the barren pond should be closed as specified in Section 8.2 of these Specifications. As heap regrading and capping progresses to the northeast beyond the heap spillway, the lateral bench drainage channel and toe drainage channel should be constructed in a corresponding, progressive fashion.

At the point where 3/4 of the ore heap has been regraded and capped, the channel leading from the heap spillway to the barren pond should be realigned to discharge into the pregnant pond and the overflow channel connecting the pregnant and barren ponds should be re-opened.

As areas of the heap become fully reclaimed with a dense cover of vegetation, runoff from these areas will not contain appreciable sediment load. At this point the surface water diversion channels in these areas should be re-aligned to discharge into the natural drainages leading to NPDES Outfall No. 003.

10.0 Reclamation and Revegetation

10.1 General Requirements

The Contractor shall furnish, transport and place all materials required to revegetate all areas disturbed during the construction activities as described herein.

In areas requiring reclamation as specified herein, the Contractor shall place a minimum of 8 inches of topsoil, salvaged during the stripping operations or obtained from topsoil stockpiles at the site, over a prepared subgrade. When placed over Type 3 soil liner/cap material, topsoil shall be placed over the compacted surface of the cap material. On steeper slopes, the compacted surface of the Type 3 material may require "dimpling" with a single pass of a sheep-foot roller or track mounted equipment, as directed by the Quality Assurance Inspector, to provide adequate bonding between the topsoil and underlying material. Other than when placed over Type 3 soil liner/cap material, topsoil shall be placed over subsoils which have been ripped to a depth of six inches immediately prior to topsoil placement to promote mixing and adhesion of the topsoil to the subsoils. In the case of subsoils requiring amelioration, as directed by the Quality Assurance Inspector, topsoil shall be placed shortly after the subsoils have been amended.

Following topsoil placement, the seed bed shall be prepared by thoroughly mixing 600 lbs/acre of 10/10/10 (Nitrogen/Phosphorus/Potassium) Fertilizer and 1,000 lbs/acre lime into the upper six inches of topsoil by discing or other suitable means. Following topsoil placement and seed bed preparation, the seed mixture in Table 1 shall be drill seeded into the topsoil material. Straw shall be applied at a rate of 1,500 pounds per acre and crimped into the soil with a mechanical crimper immediately following seeding. If seeding is conducted in late fall or winter, the seeded areas will be covered with a top dressing of potassium chloride broadcast at 150 pounds per acre at a rate which will not cause erosion. Immediately following application of the potassium chloride, straw shall be applied at a rate of 1500 lbs per acre and crimped into the soil with a mechanical crimper.

For miscellaneous area of disturbance or newly created earthen areas in natural soil materials (whether insitu or placed as fill), the available topsoil will be placed back over these soils materials and seeded as per these specifications. For reclamation of the regraded and capped heap, a minimum of 8 inches of topsoil is required.

TABLE 1
SEEDING RATES

Seed Type	Topography	
	Flat (lbs/acre)	Slope (lbs/acre)
Lespedeza cuneata		
Scarified seed (spring/summer)	16	32
Unscarified seed (fall/winter)	24	48
Fescuta arundinacea	10	20
Paspalum notatum	15	30
Panicum virgatum (fall/winter)	5	10
Lolium multiflorum (fall/winter)	10	20
(spring/summer)	8	16

Notes:
1) Quantities shown are for pounds of pure live seed per acre
2) Seed quantities shown are for drill seeding. If broadcast methods are used, the seeding rate will be doubled.

When conditions are such by reason of drought, excessive moisture, frozen soil or when in the opinion of the Quality Assurance Inspector or Construction Manager less than satisfactory results are likely to be obtained, seeding work shall be halted as directed and resumed only when conditions are favorable or when approved alternative or corrective measures and procedures have been effected.

The Contractor is to proceed with complete seeding work as rapidly as portions of the site become available, working within seasonal limitations. In any event, seeding shall be accomplished before the prepared seed bed becomes eroded, crusted over or dried out or the seed bed must be re-prepared prior to seeding. At no time shall seed be sown, drilled, or otherwise planted when the surface soil or topsoil is in a frozen or crusted state or during periods of windy weather.

10.2 Seeds

All seed shall be furnished in bags or containers clearly labeled to show the name and address of the supplier, the seed name, and lot number, net weight, origin, the percent of weed seed content, the guaranteed percentage of purity and germination, and the pounds of Pure Live Seed of each seed species in the container. All brands furnished shall be free from such noxious seeds as Russian or Canadian Thistle, European Bindweed, Johnson Grass, Leafy Spurge and Old World or Caucasian Bluestem and certified as such by the seed supplier. The Contractor shall furnish to the Quality Assurance Inspector a signed statement certifying that the seed furnished is from a lot that has been tested by a recognized laboratory for seed testing within 6 months prior to the date of delivery. Seed which has become wet, moldy, or otherwise damaged in transit or in storage will not be acceptable.

Seed types and amount of pure live seed (PLS) required per acre shall be as called for in Table 1. Seed and seed labels shall conform to all current State and Federal regulations and will be subject to the testing provisions of the Association of Official Seed Analysis. Computations for quantity of pure live seed required are based on the percent of purity and percent of germination received from each seed bag according to the following formula:

Pounds of Seed x (Purity x Germination) = Pounds of Pure Live Seed (PLS).

10.3 Fertilizers

When the use of commercial fertilizer for seeding is called for, it shall consist of a standard form or mixture of standard forms. Agricultural soil sample analyses shall be conducted by the Quality Assurance Inspector once the final soil materials requiring revegetation have been established. Soil amelioration requirements may then be revised and the Contractor's unit rates for these material shall apply.

The forms of commercial fertilizers shown in Table 2 may be used in order to provide the nutrient components required or as directed by the Quality Assurance Inspector, in order to meet the requirements recommended by tests on the soil that is to be used.

Table 2

Material	Minimum % Available Nutrient by Weight		
	N (Nitrogen)	P (Phosphorus)	K (Potassium)
Ammonium Nitrate	33	0	0
Ammonium Sulfate	20	0	0
Urea	45	0	0
Urea formaldehyde	38	0	0
Diammonium Phosphate	18	46	0
Triple Superphosphate	0	46	0
Potash (Muriate of Potassium)	0	0	60
Potassium Chloride	0	0	50

Other forms of commercial fertilizers may be used only upon written request by the Contractor and approval of the Quality Assurance Inspector.

Commercial fertilizer shall conform to the applicable State fertilizer laws. It shall be uniform in composition, dry and free flowing, and shall be delivered to the site with the manufacturer's guaranteed analyses. Fertilizer which becomes caked or otherwise damaged, making it unsuitable for use as determined by the Quality Assurance Inspector, will not be accepted. When called for by the Specifications or Quality Assurance Inspector, fertilizer of the type specified shall be applied uniformly at the rate specified and tilled into the top 6 inches of soil.

The Contractor shall furnish the Quality Assurance Inspector with fertilizer analyses, and bag weights or weigh tickets at the construction site prior to loading the machinery in preparation for fertilizing. No fertilizer shall be placed by the Contractor without the Quality Assurance Inspector's approval.

10.4 Seeding

Preparatory to seeding, the top six inches of the surface shall be tilled and brought to the desired line and grade, except where, in the opinion of the Quality Assurance Inspector, seeding follows so closely behind the initial grading or topsoil placement as to make special seed bed preparation unnecessary. Undulations or irregularities in the surface shall be leveled and existing grass, sod, weeds and seeds must be tilled under.

All slopes 2H:1V and flatter shall be seeded by mechanical power drawn drills followed by packer wheels or drag chains. Mechanical power drawn drills shall have depth banks set to maintain a planting depth of at leach one-quarter inch and not more than one-half inch and shall be set to space the rows not more than

7 inches apart. If inspections indicate that strips wider than the specified space between the rows planted have been left or other areas skipped, the Quality Assurance Inspector may require immediate resowing of seed in such areas at the Contractor's expense. Seed that is extremely small shall be sowed from a separate hopper adjusted to the proper rate of application.

When requested by the Contractor and approved by the Quality Assurance Inspector, seeding may be accomplished by means of approved broadcast or hydraulic type seeders at a rate twice that shown in Table 1. Seeds shall not be drilled or sown or otherwise planted during windy weather or when the ground is frozen, crusted, or otherwise untillable.

All seed sown by broadcast-type seeders shall be "raked in" or otherwise covered with soil to a depth of at least one quarter inch. Hand method of broadcasting seed will be permitted only on small areas not accessible to machine methods.

Seeding of portions of the areas designated may be permitted before the construction is completed in order to take advantage of growing conditions.

10.5 Manure

Manure for soil amelioration shall be barn or stable type animal droppings and shall be free of materials toxic to plant growth and reasonably free of refuse. It shall be well rotted and not have lost its strength by leaching or injurious fermentation. It shall not contain an excess amount of water and be of a consistency for readily mixing with soil to form a broken down or fine mixture.

10.6 Mulching

Materials for straw mulching as specified shall consist of straw of oats, barley, wheat or rye and shall not contain seed of noxious weeds. Straw in such an advance stage of decomposition as to smother or retard the normal growth of seed will not be accepted. Old dry straw which breaks in the crimping process in lieu of bending will not be accepted.

After seeding has been completed, hay or straw shall be uniformly applied at a rate of two tons per acre. The mulch shall then be crimped in with a mechanical crimper or other approved equipment. The Quality Assurance Inspector may order the employment of hand-crimping operations on such areas where excessive ground slopes or confined areas would cause unsatisfactory crimping to result by mechanical methods.

The seeded area shall be mulched and crimped within 24 hours after seeding. Areas not mulched and crimped within 24 hours after seeding must be reseeded with the specified seed mix at the Contractor's expense prior to mulching and crimping.

On slopes steeper than 2:1 or other specific areas which are difficult to mulch and crimp by conventional methods, hydraulic mulching or other means may be used when approved by the Quality Assurance Inspector. If adopted by the Contractor, hydraulic mulch shall consist of wood cellulose fiber mulch.

Wood cellulose fiber for hydraulic mulching shall not contain any substance or factor which might inhibit germination or growth of seed. It shall be dyed an appropriate color to allow visual metering of its application. The wood cellulose fibers shall have the property of becoming evenly dispersed and suspended when agitated in water. When sprayed uniformly on the surface of the soil, the fibers shall form a blotter-like ground cover which readily absorbs water, and allows infiltration to the underlying soil. Weight specifications from suppliers, and for all applications, shall refer only to air dry weight of the fiber, a standard equivalent to 10 percent moisture. The mulch material, accompanied with a manufacturer's certification, shall be marked by the manufacturer to show the air dry weight content. Suppliers shall certify that laboratory and field testing of their product has been accomplished, and that it meets all of the foregoing requirements pertaining to wood cellulose fiber mulch.

When required, cellulose fiber mulch shall be added after the proportionate quantities of water and other approved materials have been placed in the slurry tank. All ingredients shall be mixed to form a homogeneous slurry. Using the color of the mulch as a metering agent, the operator shall spray apply the slurry mixture uniformly over the designated seeded area. Unless otherwise ordered for specific areas, wood cellulose fiber mulch shall be applied at the rate of 1500 lbs/acre. If wood fiber hydraulic mulch is utilized, an organic tackifier shall be included in the mulch application at a rate of 100 pounds per acre.

Hydraulic mulching shall not be done in the presence of free surface water resulting from rain, melting snow or other causes.

Areas not properly mulched or areas damaged due to the Contractor's negligence, shall be repaired and remulched in an acceptable manner at the Contractor's expense.